WORKING WITH OLDER PEOPLE

Volume IV — CLINICAL ASPECTS OF AGING

a guide to practice

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WORKING WITH OLDER PEOPLE
a guide to practice

Volume I: The Practitioner and the Elderly*

Volume II: Biological, Psychological, and Sociological Aspects of Aging*

Volume III: The Aging Person: Needs and Services *

Volume IV: Clinical Aspects of Aging *

The volumes in this series were prepared from materials developed by the Projects Division, Gerontological Society, under contract PH 86–63–184 with the Public Health Service.

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WORKING WITH OLDER PEOPLE

Volume IV	CLINICAL ASPECTS OF AGING

a guide to practice

Edited by Austin B. Chinn, M.D.

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE, Public Health Service,
Health Services and Mental Health Administration, Community Health Service,
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July 1971

FOREWORD

Publication of "Clinical Aspects of Aging" marks the completion of the four-volume series entitled "Working With Older People: A Guide To Practice." This series is based principally on materials developed by the Gerontological Society under contract with the Public Health Service.

Volume I, "The Practitioner and the Elderly," focuses on aging and the world of practice related to aging. The publication puts into perspective the changing character and needs of the aging population and the implications of these changes for required programs and services. The many interdependent needs of the elderly are identified and correlated with areas of interdependence among practitioners who seek to meet these needs.

Volume II, "Biological, Psychological, and Sociological Aspects of Aging," is devoted to the basic sciences most directly related to the process of aging and the aged individual. *Biological aspects of aging* are discussed in terms of those physical characteristics which are affected by time and determined largely by genetic and environmental influences brought to bear on the individual. *Psychological aspects of aging* are discussed in terms of those functions used by the individual in adapting to his environment—his senses and perception, his ability to learn and remember, his responses, and his personality. *Sociological aspects of aging* are discussed in terms of the adjustment of the aged individual to society, with consideration given to the degree to which he is, or can be influenced by family, friends, and community.

Volume III, "The Aging Person: Needs and Services," deals with the many facets of social welfare as these relate to health status of the elderly. Included are sections on such problems as: Food, clothing, and shelter; environmental safety; mobility; leisure activities; legal protection; security and supportive services; and religion and attitudes toward death.

Volume IV, "Clinical Aspects of Aging," is written by specialists for the general practitioner and is comprised of three sections: Diseases and disorders most relevant to single organ systems; clinical problems closely related to multiple organ systems; and aspects special to allied health professions.

Special recognition is made of the efforts of Dr. Austin B. Chinn, formerly Chief of the Adult Health Protection and Aging Program, who recognized the need for these materials and who developed the means for producing them. We are particularly grateful to Dr. Chinn for giving unselfishly and unstintingly of his time in his role as editor of "Clinical Aspects of Aging."

It is hoped that "Working With Older People: A Guide To Practice" will serve as a useful tool in continuing education activities which are so vitally needed to enrich the understanding of health professionals who work with aging and aged persons.

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PREFACE

This volume had its origin in a contract between the former Gerontology Branch of the U.S. Public Health Service and the Gerontological Society. In the agreement the Gerontological Society assumed the task of bringing together knowledge relating to the health status and problems of elderly people which would be useful to practitioners of the health professions. The effort resulted in a series of volumes of which this is the fourth and last.

Much of the work done on the series took place under the direction of Mr. Harry Rosen, Project Director for the Gerontological Society. For this particular volume he worked closely with a committee of clinicians, which under the chairmanship of Dr Leo Gitman, assisted in the selection of content and in the recruitment of experts to write on appropriate subjects. Although most of the material had been assembled by the time Mr. Rosen accepted a position elsewhere (1967), it was thought that a good deal of revision remained to be done. Also, about this time the direction of the former Gerontology Branch of the Public Health Service underwent substantial change, including loss of personnel closely identified with the project, and all work toward completion of the book came to a halt. A year ago interest in publishing the series was revived, principally through the efforts of Mrs. Edith Robins, Coordinator for Health of the Aging, U.S. Public Health Service, and the undersigned agreed to assist in bringing to publishable form this volume on clinical aspects of aging.

Within the past year the request was made of all who had participated in the original writing to update their manuscripts both in content and bibliography. In almost every case the request was acted upon promptly. However, because there were a few instances in which this was not possible and also because it was thought desirable to introduce a number of new subjects, a considerable amount of new authorship is included.

Three types of problems were encountered in the final makeup of the volume.

First, the matter of writing on the health of older people without embracing that of a more generalized population. In the effort to maintain a focus on the clinical problems particularly significant to, if not exclusively of the elderly, it was sometimes difficult to decide when various considerations were suitable to this objective. If the book is to have any real value, however, it is believed essential to give to some of the health problems of the aged person special clinical visibility, even to the point of separating them from those of the remaining adult population.

Second, the matter of lack of uniformity in writing style and in depth of content among the more than 30 authors. A critical assessment readily points out such deficits. It is apparent that the treatment of some subjects may be viewed as superficial, some as overly simplified, some as primarily philosophical, and some as too technical and better suited to specialists in a given field. However, this problem is likely to be inherent in most multiauthored books and variations should be looked upon with understanding.

Third, the matter of presenting a single body of information suitable for a reading public which includes a variety of the health professions. It goes without saying that this represents a significant departure from most clinical writing. However, since health problems of the elderly require a multiprofessional approach far more often than is required for those of the young, the objective is a worthy one. It is hoped that a book on clinical aspects of the old person, which can be read profitably by physician, dentist, nurse, physical therapist, clinical psychologist, and other health professionals, will help toward better care.

Overlapping of subject material between chapters and sections of chapters will be found in many places. Discussion of certain subjects is included by as many as three or four contributors, and often there are substantial differences of opinion, particularly as to recommendations concerning treatment. These are inescapable factors wherever complex conditions with controversial features are discussed by more than one person. It is believed that these differences strengthen, rather than weaken the book by giving a choice of alternatives to be considered in the treatment of the elderly patient.

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Opinions expressed are those of the authors and do not necessarily reflect views of the Public Health Service. Trade names are used for identification only and do not represent an endorsement by the Public Health Service.

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SECTION A/DISEASES AND DISORDERS MOST RELEVANT TO SINGLE ORGAN SYSTEMS

Part I/The Integument

GERIATRIC DERMATOLOGY

By

John P. Tindall, M.D.

INTRODUCTION

The recognition of "normal" skin changes and their differentiation from those that are "abnormal" is more difficult in the geriatric age group than any other. Since the integument is so obvious, it serves as a witness to the long-term effects of an individual's inheritance, environment, biochemistry, diet, emotions, activity *and* longevity. So many variables have interacted for so long by the time one qualifies to be "geriatric," it is no surprise there is little resemblance to bygone days. These insidious changes involve the epidermis, dermis, subcutaneous tissue and appendages.

The epidermis thins generally, but sometimes thickens markedly in localized areas. The dermis becomes relatively dehydrated, loses both strength and elasticity, and has a diminished vascularity. At the same time, loss of subcutaneous fat exaggerates the dermal changes to give a folded, lined, wrinkled, and lax appearance. The hair greys and thins out in most areas, and female oil gland activity regresses toward a prepubertal status. Though this would seemingly be enough, variations in pigmentation are not confined to the hair; the skin often gets darker in some areas as the melanocytes seem to lose the ability to spread out their melanin granules in an orderly, even fashion. In a sense, skin reflects physiological age, influenced by disease and the factors listed above (fig. 1) (Idson, 1960; Palmer, 1958; Stoughton, 1962; Traub and Spoor, 1953; Wells, 1954).

FIGURE 1.—Hypertrichosis, accentuation of skin lines and seborrheic keratoses are hallmarks of aged skin.

PHYSIOLOGY AND BIOCHEMISTRY

Epidermis

The epidermis, which is the interface of the body and its environment, becomes dry and brittle with age. Blank (1952) demonstrated some years ago that the "skin barrier" of the epidermis functions to control the amount of water allowed to pass outwards from the dermis. Under most environmental conditions, the outer stratum corneum of the epidermis tends to dry out, since more water can evaporate than can be replaced by diffusion from below. The stratum corneum, however, because of a state of equilibrium, does not dry out beyond the limit of pliability at relative humidities of about 60 percent and higher. That time alters the functional capacities of the barrier is evident clinically—a loss of the suppleness and flexibility of the skin occurs with the loss of internal moisture available to the epidermis. This enhances the influence of external sources of water for hydration, or the lack of it (Sams, 1951). Proof is readily evident since simple hydration in the bath restores the flexibility which topical application of oils cannot do alone. The lubrication

of moist skin with oils, however, helps to seal in the water and prolong the beneficial effect. Gaul and Underwood (1952) concluded from their study that the dew point depressions and a low barometric pressure, followed by a sudden rise in pressure, related both to chapping of the skin and the degree and extent of the chapping. They concluded that on days with conditions conducive to chapping, bathing should be avoided. Heated houses, often with very low humidities, further aggravate the drying tendency, especially in older persons.

The epidermis is continually being shed in small flakes and particles. Visible scaling is seen when the shedding process is delayed, as in dry skin, and the dehydration described above is an obvious aggravating factor. Visible scale can also occur as a result of an accelerated epidermal proliferation—more specifically increased keratinization or formation of horny proteinaceous material from living epidermal cells. Rothman (1954) suggested the term "superkeratinization" for the process resulting in hard keratin, like nails and hair, occurring on the skin. The great importance of superkeratinization in pathologic conditions is obvious as it is the initial stage of precancerous lesions such as actinic keratoses, cutaneous horns, and leukoplakias.

The pigment-producing cells, melanocytes, are found in abundance in the epidermis. The production of melanin pigment by them is in close harmony with the other functions of the integument. The pigment granules are released to surrounding epidermal cells and contribute to the characteristic coloration of the skin and hair. The relative numbers of the melanocytes vary markedly from region to region with the greatest number being found on the head and genitalia, the least on the trunk (Quevedo, 1963). Of the various stimuli which enhance production and distribution of the granules, ultraviolet light is the most important one. Clinically, some persons do not respond to sunlight stimulation with even amounts of the protective pigment and, in place of this, freckles are formed. In later life even those who previously tanned smoothly tend to lose this ability with the result of a mottled and spotty appearance. It seems evident that melanocytes are not isolated "targets," but are members of a very complex system and therefore reflect on their neighbors, such as the dermis (Fitzpatrick et al., 1961).

Dermis

The changes in the dermis attributed to aging are in reality those of chronic sunshine exposure and short-wave length ultraviolet light. In a series of patients of varying ages and degrees of pigmentation, Knox and associates (1962) showed no histologic evidence of any degenerative dermal changes in any of the biopsies of skin from the buttocks. Also, none of the skin sections from Negroes, including those from the face and arm, showed any changes. The extent of damage in Caucasians reflected age, degree of sunlight exposure, and complexion with great consistency. Unna (1896) felt that the histologic changes of dermal fibers—swollen, fragmented, clumped, and amorphous-appearing—represented contributions of both collagenous and elastic fibers to make up the mass of degenerated tissue. The studies of Mackie and McGovern (1958) showed the first change to be the appearance of curled and twisted elastic fibrils in the upper dermis around the vascular plexuses. They increase in number to form a dense mat until the fibrillar structure is lost and only a mass of homogeneous material remains. Special histochemical stains showed the mass to be like elastic tissue associated with large amounts of neutral and acid mucopolysaccharides (Sams and Smith, 1961). Because other factors are involved in the process besides time and age, Becker (1959) more properly termed the changes *actinic elastosis* rather than *senile elastosis.*

Biochemical studies reported by Smith and colleagues (1961) showed the composition of the material in the upper dermis in actinic elastosis to be very similar to elastin and markedly dissimilar to collagen. The amino acid composition also showed an increased amount of lysine in the elastin of actinic elastosis (Smith et al., 1963). This would suggest that because there is less lysine in the skin of adults as compared to that in infants, the elastin of actinic elastosis represents recently synthesized material (Sams and Smith, 1965). Increased amounts of hexosamine in actinically damaged skin confirmed biochemically the histochemical evidence of increased neutral and acid mucopolysaccharides (Smith et al., 1961).

These alterations in connective tissue give the skin the appearance referred to as "aging"—the coarse, wrinkled appearance of the sun-exposed skin. But of far more than cosmetic importance, it undoubtedly predisposes the skin to development of precancerous and cancerous growths. Mackie and McGovern (1958) feel that the nutrition of the epidermis is altered, producing the neoplasms. The exact mechanism is not entirely clear, but the fact that altered dermis is necessary does

seem clear (Orr, 1963). Van Scott and Reinertson (1961) showed that transplanted basal cell skin cancers would not survive without their stromal environments.

The Pilosebaceous Unit

Changes in hair are evident in aging, particularly if one regards birth to senescence as the spectrum of aging. Most changes in hair actually occur before 60 years of age and so the end result is what is observed in the geriatric person. Scalp hair is lost with increasing maturity in both sexes. Hair patterns of the eighty males in the Duke University study survey revealed: 9 full male, 33 early W-shaped, 14 late W-shaped, 21 U-shaped and 3 O-shaped distributions. These patterns are derived by viewing the scalp from above and behind. Though not specifically recorded, several women had early W-shaped distributions, an apparent physiologic post-menopausal change such as described by Beek (1951). Greying was not studied, as heredity probably is the dominant factor and was outside the scope of this study. Interestingly enough, hair that has not lost its pigment darkens with age (Trotter, 1930).

Historically, the Duke Series patients related that about half of them noted no change in the amount of eyebrow hair, while one quarter had increased and one quarter had decreased amounts. If they noted any change in axillary or pubic hair, it was almost always decreased; but facial hair was always increased. These three changes were interrelated statistically and all were significantly related to elevated cholesterol levels but not to arteriolarsclerotic retinopathy, coronary artery disease or aortic calcification. All the men in the group had coarse hairs in the external ear canals, a persistent secondary sex characteristic. Only 30 members of the 163 noted a change in amount of hair on their lower extremities, 24 of them indicating less hair (Tindall and Smith, 1963).

Hormonal influences are far more important to any understanding of changes of hair distribution than aging as such. It has been shown that there is not a single area which is hairy in men that may not become hypertrichotic in women under pathologic conditions (Beek, 1951). The adrenal cortex, the pituitary, the gonads, and the thyroid all affect the amounts of hair growth (Rothman, 1954).

The sebaceous glands are also greatly influenced by hormones, especially sex hormones. Smith (1959) particularly studied the aged sebaceous gland and found no significant difference in sebaceous gland excretion of the aged male as compared with the adolescent male, though the aged male gland responded to parenteral testosterone with increased excretion. The aged female sebaceous gland function, however, was significantly decreased when compared with the adolescent female. The aged female sebaceous gland responded with increased excretion to the administration of parenteral progesterone. The effects of hormone administration in the aged patients disappeared within 7 weeks of cessation of the therapy.

Another study (Schweikert, 1968), concerned with sebaceous gland function in male pattern baldness, investigated sebum production from the temporal areas of the forehead, from the frontal areas of hair loss, and from the crown. The author concluded that not only was high secretion output maintained, but also there were increases with progressive duration of the disorder.

These studies were of the face and scalp. The sebaceous glands in other areas are certainly preserved anatomically in older skin, but the function is generally assumed to be diminished (Wells, 1954). More work must be done before there is really significant understanding.

Sweat Glands

The sweat glands are also felt to decrease in function with age, while remaining intact anatomically (Wells, 1954). Using pain and epinephrine as stimuli, Hurley and Shelley (1960) studied 35 normal male adults (ages 15–50 years) and 11 elderly adult males (ages 60–75 years). All of the normal adults responded with varying degrees of axillary apocrine sweating to the epinephrine, but only 6 of 11 in the older group responded by apocrine sweating. To the pain stimulus, the results were 14 of 35 and 3 of 11, respectively.

Apocrine sweating is of little importance to the human when compared to eccrine sweating. Temperature regulation is a highly important function of the skin. Henschel and associates (1968) studied heat tolerance in elderly persons living in a subtropical climate by stressing them with exercise and heat. A group of 38 women (average age of 69 years) and 62 men (average age of 72 years) were studied. They concluded, "These elderly persons were able to tolerate the work-in-heat stress without evidence of excessive physiological strain." This is especially important in view of the large numbers of retired persons seeking warm climates for their remaining years.

The only conclusion one can draw in relation to aged sweat glands is that though they may function less

than in younger adult life, there is probably not a significant effect on the body unit.

CLINICAL CONDITIONS

Incidence

A simple incidence of skin physical findings in a group of elderly persons over 64 years of age is shown in table 1. The group carefully reflects the Durham, North Carolina community area for sex, race, education, and living status and all were ambulatory. The ratio of Caucasian to Negro was about two to one. Of the first 9 diagnoses listed, only dermatophytosis is usually regarded as abnormal. The high incidence would suggest that fungal infections of toewebs and toenails, usually asymptomatic, are not generally real problems.

Table 1.—Incidence of Skin Lesions in 163 Subjects (Age 65+) at Duke University Medical Center

Diagnosis	Percent	Comment
Lax skin	94	
Seborrheic keratoses	88	
Comedones (blackheads)	81	
Dermatophytosis	79	
Asteatosis (dermatitis hiemalis)	77	
Cherry angiomas	75	94 Caucasians of 122 with disease
Nevi	63	
Skin tags	56	
Lentigos	51	72 Caucasians of 84 with disease
Varicosities	48	
Seborrheic dermatitis	31	
Schamberg's disease	31	25 Caucasian males of 51 with disease
Milia	30	
Spider angiomas	29	43 Caucasians of 45 with disease
Actinic keratoses	28	All Caucasian
Dermatosis papulosa nigra	13	All Negro
Neurogenic excoriations	12	
Rosacea	12	All Caucasian
Venous lakes	12	15 Caucasians of 19 with disease
Senile purpura	9	12 Caucasians of 14 with disease
Cafe-au-lait spots	8	10 Negro of 13 with disease
Eczematous dermatitis	8	10 Caucasians of 13 with disease
Contact dermatitis	7	
Pruritus ani	7	
Basal cell carcinoma	6	All Caucasian
Sebaceous adenomas	6	8 Caucasians of 9 with disease
Cysts (epidermoid and sebaceous)	4	
Statis dermatitis	3	
Keratosis pilaris	3	
Leukokeratosis (oral)	3	
Squamous cell carcinoma	2	All Caucasian
Purpura	2	All Caucasian
Xanthelasma	2	
Rhinophyma	2	All Caucasian
Lichen sclerosis et atrophicus	1	All Caucasian
Psoriasis	1	All Caucasian

Table 2.—Ranking of 30 Most Common Dermatosis. (After Welton and Greenberg, 1961; 1964)

[Extracted for 60+ age group only]

List in order of total visits per diagnosis		List in order of percent of total patient visits	
1. Epithelioma [1]	955	1. Epithelioma	53.5
2. Keratoses [1]	578	2. Vascular group	48.9
3. Eczematous dermatitis [1]	386	3. Keratoses	46.7
4. Neurodermatitis, other [2]	395	4. Herpes zoster	36.1
5. Psoriasis	219	5. Dermatitis herpetiformis	29.7
6. Vascular group [1]	202	6. Neurodermatitis, other	21.5
7. Fungus group	167	7. Eczematous dermatitis	20.3
8. Seborrheic dermatitis	148	8. Lichen planus	19.5
9. Venenata, acute	147	9. Neurodermatitis, anogenital	19.4
10. Venenata, chronic	141	10. Psoriasis	17.6
11. Pyoderma	118	11. Anogenital pruritus	17.1
12. Wart [3]	83	12. Cysts	16.9
13. Nevus [3]	71	13. Seborrheic dermatitis	16.1
14. Erythema multiforme	61	14. Erythema multiforme	15.1
15. Atopic dermatitis [4]	55	15. Venenata, chronic	14.0
16. Cysts	51	16. Venenata, acute	12.5
17. Neurodermatitis, anogenital	47	17. Pyoderma	12.0
18. Acne [4]	47	18. Actinic group	11.5
19. Lichen planus	41	19. Fungus group	11.4
20. Alopecia [4]	37	20. Keloid	10.2
21. Actinic group	37	21. Nevus	8.9
22. Herpes zoster [1]	35	22. Herpes simplex	8.9
23. Dermatitis herpetiformis [1]	27	23. Alopecia	7.6
24. Anogenital pruritus [1]	22	24. Atopic dermatitis	6.3
25. Dyshidrosis [4]	16	25. Dyshidrosis	5.4
26. Herpes simplex [4]	13	26. Wart	4.8
27. Keloid	12	27. Pityriasis rosea	1.1
28. Pityriasis [3]	3	28. Acne	.9
29. Hemangioma [3]	2	29. Hemangioma	.7
30. Bacterid and pustular psoriasis [3]	0	30. Bacterid and pustular psoriasis	0

[1] Age group had highest incidence.
[2] Age group had next highest incidence.
[3] Age group had lowest incidence.
[4] Age group had next lowest incidence.

For comparison, there are a number of articles on incidence of skin lesions in elderly persons living at home (Droller, 1955), living in a nursing home (Zakon et al., 1952), as outpatients seeking medical attention (Horne, 1959; Kennedy et al., 1950; Lane and Rockwood, 1949; Noojin and Osment, 1957; Young, 1958), and as hospitalized patients (Young and Miller, 1968).

A most comprehensive survey was undertaken by Welton and Greenberg (1961) involving 50 board certified dermatologists, each devoting 75 percent or more time to private practice. The location and distribution of all dermatologists in the United States was: Northeast—42 percent, South-Southeast—11 percent, Midwest—23 percent, Southwest—8 percent, and West—16 percent. The authors thus determined the relative numbers of practitioners from each area to comprise the 50.

Patients aged 60 and more provided 15.9 percent of all patient-diagnoses, based on 25,188 total patients.

This was next to the largest age group, the largest being those of the second decade. Table 2 is a list of the 30 most common diagnoses in the total group, taken from Part III of the survey (Welton and Greenberg, 1964). Females accounted for 56.5 percent and males for 43.5 percent of the patient-diagnoses, while non-white patients comprised only 2.5 percent of the total. Three-quarters of these were Negroes.

For better understanding of Table 2, it should be pointed out that neurodermatitis was divided so that if it involved the anogenital area, this rated separate listing. "Other" neurodermatitis included all other forms except atopic dermatitis. Anogenital pruritus which was not felt to be on the basis of neurodermatitis was separated also. The vascular group included stasis dermatitis, both with and without ulcers; purpura; pigmented purpuric eruptions, such as Schamberg's disease; and hematoma. The actinic group was comprised of lupus erythematosus and polymorphic light eruption. The wart category excluded seborrheic wart, which is best termed seborrheic keratosis, and was placed with actinic keratoses to make up the keratoses. Contact dermatitis, or venenata, was more meaningfully separated into acute and chronic. The category dermatitis herpetiformis included bullous pemphigoid, the blistering disease of the aged. All in all, this is a most complete and comprehensive survey for dermatologic problems.

Dermatitis

Dermatitis in the aged has two generally accepted characteristics: (1) it is more refractory to treatment, and (2) causes more distress than in young counterparts. Epstein (1946) estimated that dermatitis in the 45 to 65-year age group took twice as long to clear as in young adults. The majority of instances of dermatitis is due to irritants superimposed on dry, already itchy skin. However, true sensitizations do occur. Kligman (1958) found only one-fourth as many reactors to poison ivy in the older age group when compared to young adults in the third decade. In a study done in England where poison ivy does not occur naturally, 19 of 45 adults under 50 years of age were sensitized to pentadecylcatechol (poison ivy antigen) with a single exposure and challenged one month later. In a second group tested under similar conditions (aged 60 to 94), only 4 of 45 became sensitive (Tindall and Crow, unpublished). Smith and Kiem (1961) also found pentadecylcatechol antigen sensitivity to be decreased in the aged. However, when they used other potent sensitizers (dinitrochlorobenzene and paranitrosodimethylaniline) not previously encountered, the aged group developed the same degree of sensitivity as the youthful group. Important allergens are nickel (jewelry), chromates (metal and leather goods), mercury containing medications, paraphenylenediamine (dark blue and black dyes), and formaldehyde (especially drip-dry and crease-resistant clothing) (Baer et al., 1964). Rubber antioxidants and the sunlight sensitizing properties of antibacterial soaps are also important (fig. 2) (Odom and O'Quinn, 1968. Allergic dermatoses, according to Baer and Schwarzschild (1955) are somewhat less common than in younger people. The 3 most common allergic eruptions in persons over 50 are allergic eczematous contact dermatitis, allergic drug eruptions and allergic urticaria. Medications, both topical and systemic, are relatively common causes of allergic eruptions in older people. Atopic dermatitis persists rarely after 50 years of age.

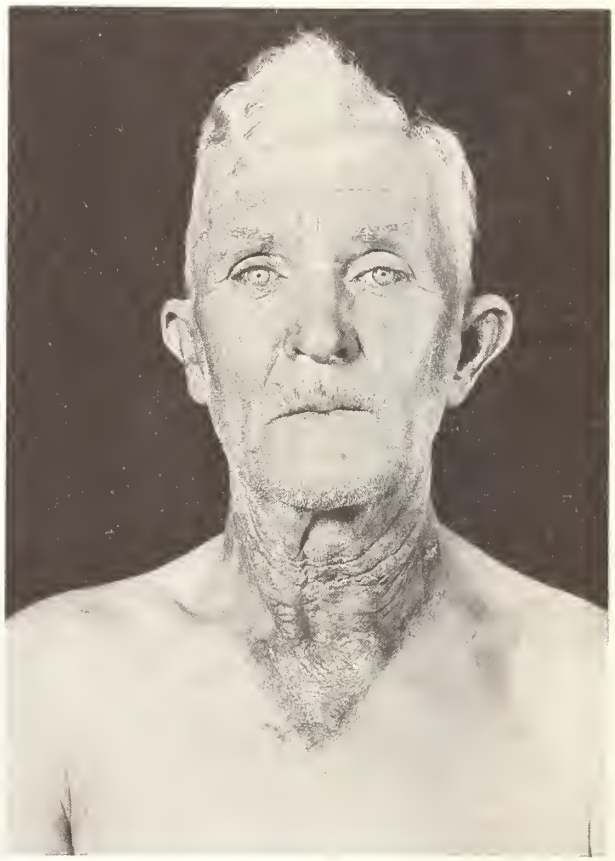

FIGURE 2.—Sensitivity to sunlight in an elderly patient secondary to using antibacterial soaps.

Seborrheic dermatitis is an inflammatory dermatitis apparently induced by the trapping of irritating natural oils, especially the fatty acids, in the outer scaly layer of skin. The incidence in the Duke Series (51 of the 163 subjects) broken down by sex revealed: 30 of 74 men and 21 of 83 women. One would expect a higher incidence in men since they maintain their sebaceous gland activity and women do not (see above). Only 8 subjects were considered to have moderate or severe cases, though 14 had involvement of the scalp as well as elsewhere on the body. Other common areas include the eyebrows, sides of the nose and adjacent cheeks, post-auricular areas, external ears, and overlying the sternum in men. Young (1969) found an incidence of 18 percent of 388 patients in a chronic diseases hospital, presumably more severe than patients in the Duke Series.

An increased oiliness, particularly of the forehead and cheeks, has so frequently been seen associated with postencephalitic Parkinsonism, that many clinicians regard it as a helpful diagnostic sign. Pochi and colleagues (1962) reported that not only is sebum production significantly increased in patients with Parkinsonism, but the increase occurred in the idiopathic disease as well as the postenchephalitic syndrome. To a lesser extent, the sebum secretion was also higher than normal in patients with other neurologic diseases. However they could find no urinary 17-ketosteroid differences from normal controls of the same age to account for the increased production of the sebum. Though the possible influence of the extrapyramidal system on sebum secretion was raised, they felt that damage to the basal ganglia per se was not specific for the development of glandular hyperplasia in Parkinsonism.

Rosacea, another oil gland related problem, is a chronic inflammatory disorder of the sebaceous glands of middle-aged or older persons. It is usually localized to the middle half of the face and is always associated with erythema, though the individual lesions may be papules, pustules or telangiectasias in varying proportions. The incidence in the Duke group of patients was 12 percent, all 20 being Caucasian including 2 women. Three of the men had rhinophyma, hypertrophic "bulbous" enlargement of the nose, as a late sequela.

Since a relationship between rosacea and seborrheic dermatitis obviously exists, treatment is similar for both conditions. Frequent shampooing, alternating between tar-basd, sulfur-based, and salicylic acid-based shampoos is essential. Drying, peeling regimens using topical acne agents of similar nature, and local steroid preparations are very helpful. Systemic antibiotics, such as tetracycline, are sometimes helpful in controlling severe and refractory cases.

Ectasias

Bean (1958) has written in great detail on "vascular lesions which increase with aging." The cherry angioma (senile angioma, de Morgan spot) is composed of a localized overgrowth of dilated vessels, only occasionally larger than 3 mm. in diameter. By the eighth decade, he found 100 percent of patients of both sexes had one or more of the lesions. The Duke University Medical Center incidence was 75 percent (94 of 104 Caucasians and 28 of 59 Negroes). Sixty-three subjects had more than 10, and 76 had lesions on both the trunk and extremities. Forty-one of the 122 had trunk lesions only.

Scrotal angiomas were also tabulated in the Duke survey. They were found in 41 percent of Caucasian men but only 4 percent of Negro men. Evaluation for association of vascular lesions—scrotal angiomas, varicosities and cherry angiomas—showed significant values by Chi-square testing, particularly the scrotal and cherry angiomas with a value of .001 (Tindall and Smith, 1963). Kocsard and collegues (1970) reported their findings in 390 male subjects (all presumed to be Caucasians) and concluded any cross-relationship between the variety of vascular lesions to be accidental. There did not seem to be any meaningful information in the Duke group of patients when P values were determined utilizing figures of these vascular lesions in association with arteriolarsclerotic retinopathy, aortic calcification, and coronary artery disease.

Low-Grade Infections

Superficial and dermatophytic (tinea) fungus infections are common in elderly persons, but are not usually problems. In the Duke series of 163 subjects, only 33 had no evidence of fungus infection on their feet. Fourteen had tinea pedis only, 39 had nail involvement only, and 77 had both. Only one patient had clinical evidence of tinea versicolor, a superficial fungus infection with a predilection for the trunk. The patients were not examined with a Wood's lamp. With this aid, 89 of 504 (17.4 percent) elderly persons in another study (Michalowski and Rodziewicz, 1965–a) had evidence of the fungus. The involved areas did not actually fluoresce but detection was easy using the light source. The incidence of erythrasma, a low-grade bacterial infection involving the intertriginous and moist

areas of the body, was found in 10 percent (33 of 328 patients 65–99 years) of elderly women in Michalowski and Rodziewicz's survey (1965–b).

Should either of the superficial-type infections need treatment, Safeguard (R) soap, is effective against the erythrasma, easily diagnosed in toewebs, groins, axillae and under breasts by the coral red fluorescence under the Wood's lamp (Dodge et al., 1968). Tinea versicolor can be readily peeled off by applying Selsun (R) shampoo twice weekly for 2 weeks, allowing skin contact for 5 minutes before rinsing.

The main problem with fungus infections is in the elderly diabetic (fig. 3). A low grade toeweb infection

FIGURE 3.—Chronic low-grade infections plague the diabetic—in this case, moniliasis.

gives bacteria an excellent opportunity to invade, especially since fissures and small breaks in the epidermis are so common. In a review of 541 diabetic patients, 89 (16.5 percent) had a primary problem involving the foot or leg, and infection was the cause of many of them (Whitehouse and Block, 1964). Tinactin(R) lotion or cream, which is not irritating like the peeling agents, is very useful against the tinea organisms and can often be helpful with only 2 or 3 applications a week. Yeast infections, or moniliasis, can be a problem in the toewebs. Mycolog(R) cream effectively reduces the yeast and bacterial flora in most cases. Good cleansing and careful drying always is helpful. The relapse rates of all these skin infections are relatively high.

Actinically Damaged Skin

General Comment. Having established a real and direct relationship between the changes of chronic sun exposure and the development of precancerous and cancerous growths on the skin (fig. 4), what can be

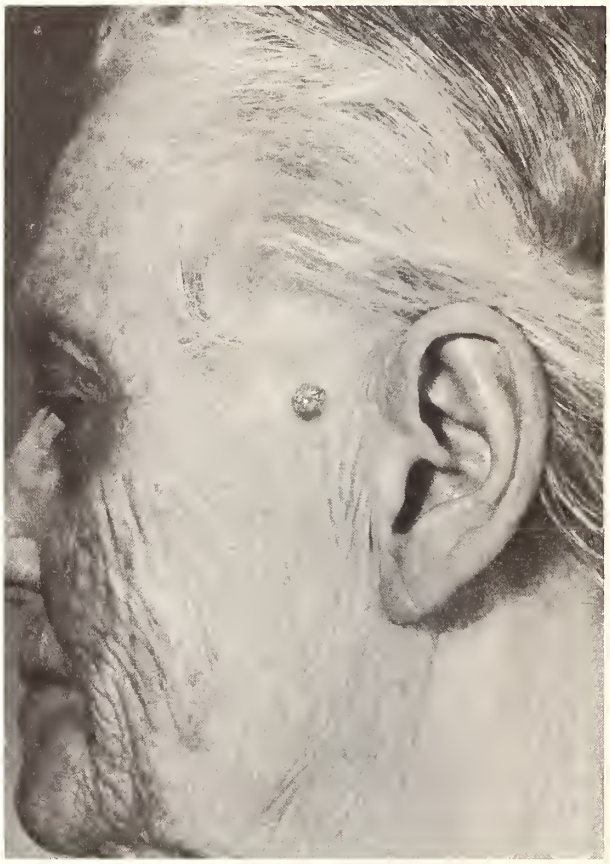

FIGURE 4.—Chronic sun exposure has "aged" the skin of this 64-year-old, and contributed to the basal cell epithelioma in front of her ear.

done to benefit persons with moderate to marked changes? Obviously, prevention of cancer is more logical than simply awaiting its arrival. The use of sunscreens such as "Block Out"(R) or "A-fil"(R) can benefit all such persons. Pathak and associates (1969) have recently provided a complete comparison of sunscreens. Avoidance of sun exposure during the hours of intense, shortwave length ultraviolet light, i.e. between 10 a.m. and 3 p.m., is important in all ages. Earlier and later hours do not deliver large quantities to the earth's surface because of the ozone filter and the length of the path through which the light must pass (Daniels, 1962).

Topical chemotherapeutic agents are evolving as an

excellent treatment modality for ridding the patient of his "reactive" epidermis and leaving a highly satisfactory cosmetic aftereffect. Edmund Klein (1968), a pioneer in this field, points out that administration should be topical and should have good selectivity for the cancerous and precancerous lesions. These agents allow high concentrations in small areas, are especially useful in the treatment of large lesions, and allow identification of early primary skin cancers by the induced reaction. Klein's experience at the time of his report included over 5,000 lesions in more than 300 patients during a period of greater than 5 years. The specific agent most often used topically is 5-Fluorouracil, usually a 0.5 to 2 percent solution in propylene glycol. The 1 percent concentration is most commonly used and the medication is applied once daily until a moderate inflammatory response has been induced. The applications are then stopped in favor of a soothing anti-inflammatory cream, e.g. Valisone(R), Cordran(R), Synalar(R). The inflammatory response takes from 10 days to 4 weeks, and the healing time is about 3 weeks. Lesions not removed by this method are either unimportant and benign, or are more invasive and require more aggressive therapy. Retreatment is more easily and conveniently performed than the initial one since there are fewer lesions. Honeycutt and associates (1970) have recently provided a review of topical antimetabolites and cytostatic agents.

Another method with some merit has been dermabrasion, or surgical planing. The abrasion removes not only the end-organ epidermis but also the dictating force, the upper third of dermis. This should, therefore, be a longer lasting modality. Epstein (1966) has reported definite benefit in 8 of 10 patients followed for 8–12 years. A survey he conducted in 1961 (Epstein, 1963) revealed that 194 of 1,075 dermatologists replying to his questionnaire had used dermabrasion to manage precancerous skin. Of them, 18.5 percent reported excellent results and 59.5 percent felt the results were good. Burks and associates (1963) also felt their patients benefited. This method of treatment should be reserved for those specifically trained in its use.

Cheilitis. A special word seems appropriate concerning chronic actinic cheilitis (fig. 5). Because of the prominence of the lower lip, the great majority of persons with chronic sun damage have the disease confined to that area with sparing of the upper lip. Nicolau and Balus (1966) found 542 patients with more or less well-defined lesions of actinic cheilitis and added 76 more patients who already had displayed epithe-

FIGURE 5.—Actinic cheilitis in an elderly woman.

FIGURE 6.—Several darkly pigmented, flat lentigines can be seen on the dorsum of the hand and wrist. The large lesion with the hard, keratotic center is a keratoacanthoma of five weeks' duration.

liomas. Ninety percent of the patients stated the cheilitis appeared in the warm season as a consequence of prolonged sun exposure. A sunscreen like A-fil(R) sunstick should always be used in these persons whenever they are out of doors.

Lentigo Senilis. Three other lesions occur in the exposed areas of skin. Among these is lentigo senilis, or "liver spots" (fig. 6), which was recognized to be different from ephelides or freckles in the Sutton (1939) textbook. Cawley and Curtis (1950), in their definitive paper, also distinguished them from true lentigines. They found the senile (better called "actinic") lentigines to seldom occur before the fourth or fifth decades, slowly increasing in number with advancing age. The dorsal aspects of the hands and wrists are the most common sites of the lesions but they are also seen, though less frequently, on the face and ankles. They can number up to several dozen. Cawley and Curtis (1950) state that they occur in 25–30 percent of persons over 50 years of age (69 percent of white subjects in the Duke series had one or more on the hands and wrists) though many elderly persons are free of them. Hodgson (1963) found 90 percent of his elderly subjects to have the senile lentigines and that the incidence increased with age. He related the lesions to the degree of "senile" change in the skin and felt that chronic sunlight exposure was an important etiological factor in their development. No sex difference has been noted; however, a racial difference is evident as only 20 percent of Negro subjects in the Duke series demonstrated the lesions. Though they are called "liver spots", they have no relation to any internal changes or disease.

Senile Purpura. This is another common lesion in the elderly occurring on exposed surfaces. Only 9 percent of the Duke series (table 1) had the lesions which is an abnormally low figure; perhaps it can be accounted for by the fact that the patients were seen only one time. Droller's survey (1955), which included white patients only, showed an incidence of 78 percent. The phenomenon is related to the connective tissue changes described above. If one injects red blood cells suspended in saline into the human dermis, a purpuric-ecchymotic lesion is produced and persists some 3 to 4 weeks. If, however, the patient's red cells are diluted with sterile water and injected intradermally, the blood is picked up in a normal fashion. Absorption of a wheal of saline is greatly prolonged in sun damaged areas compared to protected areas (Engel and Smith, 1963), and is another measure of the difference in connective tissue which has been actinically damaged.

These lesions were first described by Bateman (1818) as "purpura senilis, scurvy of old age." Tattersall and Seville (1950) found no relationship with cardiovascular and hypertensive disease, or with Vitamin C. Histologic sections show that "the small blood vessels appear to have lost their connective tissue support" (Wells, 1954) which seems the most plausible explanation for the extravasation of the red blood cells. There are two other situations wherein connective tissue changes will predispose to long-lasting ecchymotic areas. These are chronic acidosis and chronic hypercorticism (Smith et al., 1966). The lesions in these disorders, however, are on protected skin as well.

Spontaneous Pseudoscars. Another lesion, long seen and appreciated by clinicians, has been recently termed "spontaneous pseudoscars" by Colomb and associates (1967) (fig. 7). The skin of exposed areas, especially

FIGURE 7.—A large pseudoscar can be seen in the center of the dorsum of right hand. The small arrows indicate actinic keratoses, the larger arrows show senile purpura, and the largest arrow points to a squamous cell carcinoma treated by irradiation.

the forearms, appears atrophic with a thin epidermis. The lesions are scar-like but without loss of substance. In the group of patients described, 91 percent of those with Bateman's senile purpura had one or more of the pseudoscars. A difference, however, is that the pseudoscars persist indefinitely, while the purpura is characterized by recurrences and remissions.

Actinic Keratoses. These lesions (also termed solar or senile keratoses) are more important since they are precancerous, with estimates as high as 20 percent degenerating into squamous cell carcinoma (Becker and Brennan, 1961) (fig. 8). This figure depends on pathologic criteria, and the experience at Duke University Medical Center approaches an incidence more like 5 percent. These lesions brought the largest number of patients to Lane and Rockwood (1949), and ranked in the first three categories in four other series (Horne, 1959; Kennedy et al., 1950; Noojin and Osment, 1957; Young, 1958). The keratotic lesions are light in color, producing "hard" keratin which occasionally builds up to become a cutaneous horn (fig. 8). They are seen only on the exposed areas of the skin, e.g. face, neck, dorsa of hands and arms and the outer borders of the ears; and they are associated with at least *minimal erythema.* The small lesions can easily be destroyed by freezing with CO_2 snow or liquid nitrogen, or by electrodesiccation. The larger lesions should be removed so the bases can be destroyed more thoroughly by electrodesiccation, or they can be excised surgically.

Basal Cell Epithelioma (Carcinoma)

The most common skin malignancy is the basal cell epithelioma (BCE), usually a nodular or nodulo-ulcerative lesion with a raised, pearly border across which one can see telangiectatic vessels (fig. 9). Occasionally,

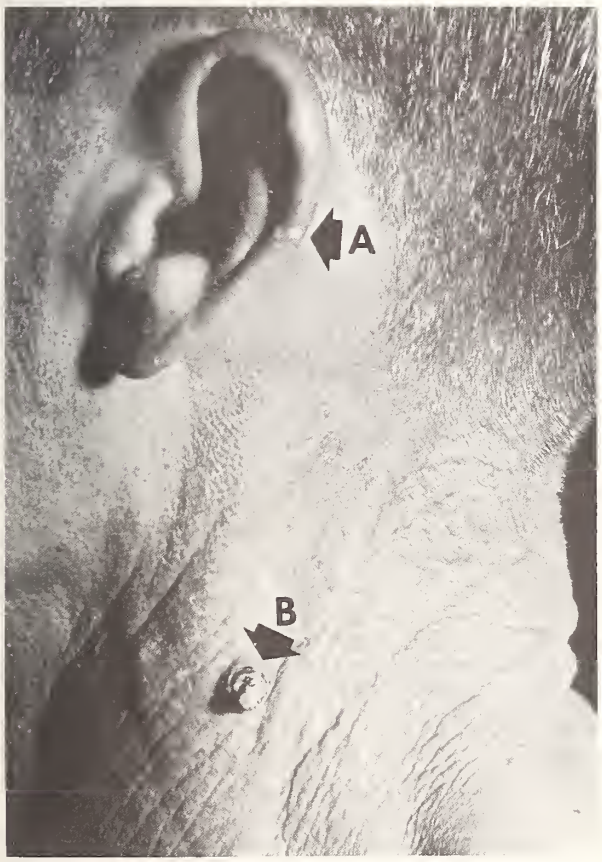

FIGURE 8.—A points out two actinic keratoses on rim of the ear. B indicates a cutaneous horn which had an early squamous cell carcinoma in the base.

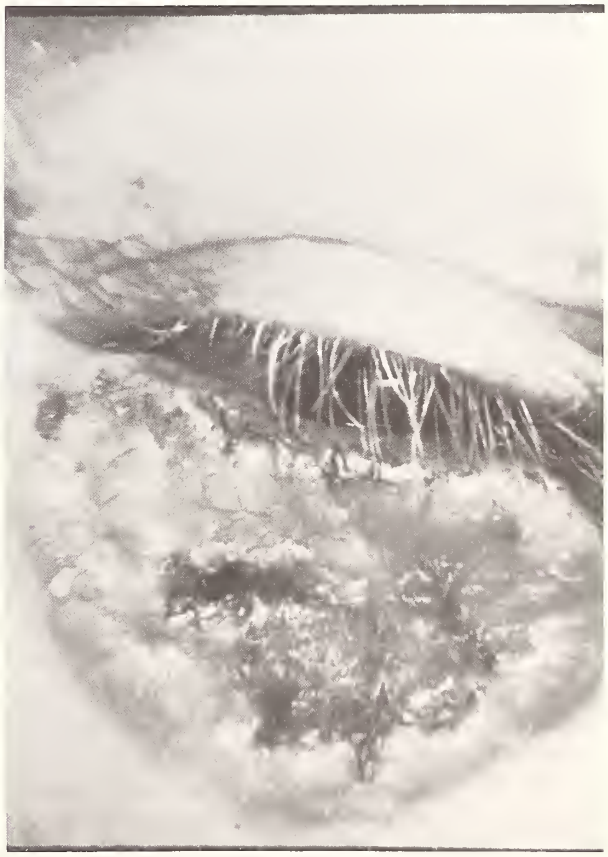

FIGURE 9.—Huge basal cell epithelioma of 17 years' duration. Note pearly appearance, telangiectasia, and early breakdown in center.

the lesions are pigmented, making them difficult to distinguish from the other pigmented lesions described below. When the nodule enlarges, it tends to ulcerate in the center giving rise to the "rodent" ulcer (fig. 10). As

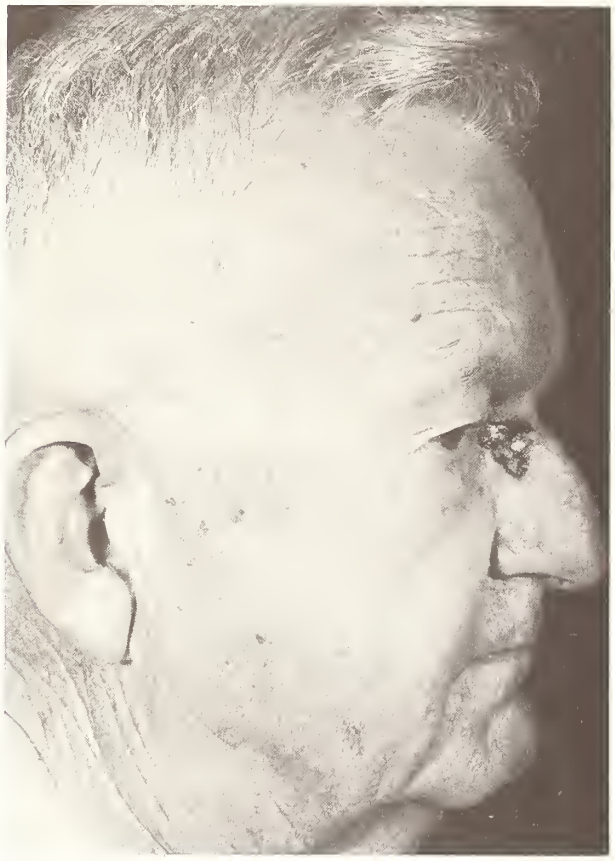

FIGURE 10.—More destructive basal cell epithelioma eroding the nose, known as a "rodent ulcer."

a rule, these lesions lack the capacity to metastasize with only very rare reports to the contrary (Lever, 1967, p. 577). The average age of onset of BCE's is 57.3 years (Schrek and Gates, 1940). Treatment varies with the size, location and depth of the lesion. Knox and associates (1967) reviewed the cure rates of the 3 most common modalities: curettage with electrodesiccation, irradiation, and surgical excision and found 97.5 percent, 96.4 percent and 95.7 percent 5-year cure rates respectively for lesions less than 2 centimeters in diameter. Elliott and Welton (1946) obtained a 97.1 percent 5-year cure-rate of 1,742 patients with unclassified skin carcinoma by curettage and desiccation followed by roentgen therapy. Mohs' (1956) chemosurgical technique has a definite place in the treatment of skin cancers, especially in extensive lesions and in failures from previous treatment. Zacarian (1969) has gotten excellent cure rates and cosmetic appearance from his deep freezing technique, but at the moment, like Mohs' technique, this is in the hands of a few skilled operators (Phelan, 1968).

The simplest treatment for most BCE's is performed by cutting around the periphery of the anesthetized lesion with iris scissors, then lifting the top off for pathologic examination. A small curette is then used to scoop out the soft cancerous tissue, following which the lesion is thoroughly electrodesiccated and the last two steps repeated. The cosmetic effect is perhaps less satisfactory than surgical excision, depending on the lesion, but the ease of the procedure and high cure rate make it the author's personal choice for most lesions.

Basal cell carcinomas are sometimes seen confined to the epidermis and designated "superficial" in type (fig. 11). The above treatments can be used, but topical

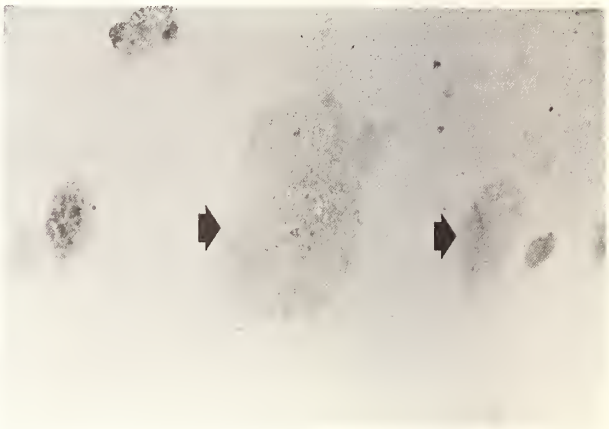

FIGURE 11.—Two superficial basal cell epitheliomas. The larger lesion has a well-defined, slightly raised, border, typical of the BCE's.

chemotherapeutic agents are proving highly satisfactory, both in ability to cure the lesions and to leave little or no scarring.

Squamous Cell Carcinoma

Squamous cell carcinomas, though less often encountered than the basal cell carcinoma type, do have metastatic potential (fig. 12) (Lund, 1965). These lesions generally evolve from actinic keratoses but may lack the pearly border of the basal cell carcinoma. Instead, one sees a flesh-colored nodule which may ulcerate.

FIGURE 12.—Squamous cell carcinoma, slowly growing and just becoming ulcerative.

They occur at a later average age than basal cell types, 66.2 years, though both malignant lesions can and are seen in the same individual (Schrek and Gates, 1940). If a line is drawn from the corners of the mouth to the earlobes, about two-thirds of the skin cancers above the line are basal cell in type, while below the line two-thirds are squamous cell in type. The lower lip, in particular, is a problem area because of the tissue involved and the blood supply. The lymphatic drainage is so good that a hyperkeratotic lesion on the lower lip is treated more vigorously than in most locations. For these small keratoses, a "lip shave," done by removing the skin of the lip from the vermillion border to the mucous membrane and then suturing the margins together, is an excellent procedure. For larger keratotic lesions and squamous cell cancers, a V-type wedge section will often adequately remove the lesion and give a good cosmetic result. Smaller, isolated keratotic lesions are amenable to freezing or electrodesiccation as in other areas, with good healing the rule.

Most squamous cell cancers can be treated by the same methods as BCE's—curettage and electrodesiccation, irradiation, and surgical excision are used most frequently. In the Knox et al. series (1967), there were 99.5 percent, 91.1 percent and 93.3 percent 5-year cures respectively for lesions less than 2 centimeters in diameter. Again, the Mohs and the Zacarian techniques are good, though more specialized. Cure rates are almost as high as with BCE's.

Bowen's disease, or intraepithelial squamous cell carcinoma, deserves a special note (fig. 13). The tumor

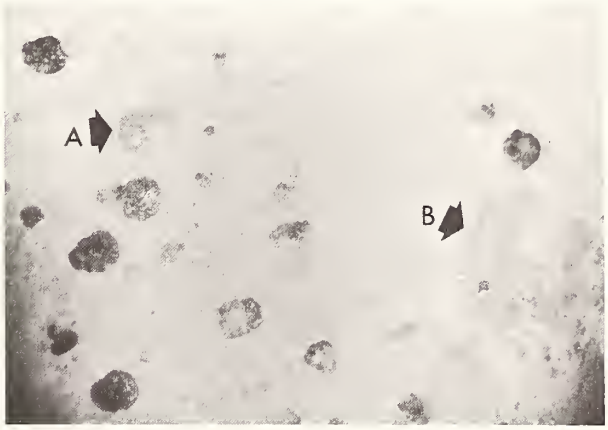

FIGURE 13.—Multiple new growths on the skin. They are all seborrheic keratoses except: (A) which is a basal cell epithelioma; and (B) Bowen's disease.

can be multiple or single, and arises not infrequently as a result of inorganic arsenic ingestion. Yeh and associates (1968) found 121 Bowen's tumors out of 238 arsenical skin cancers associated with chronic arsenic ingestion from well water. Fowler's solution, though no longer commonly used, was formerly in vogue for therapy for asthma, psoriasis, pemphigus and other diseases. These persons, after some years, develop keratoses similar to actinic keratoses, but they occur on all surface areas, and characteristically on the palms and soles. The diagnosis can sometimes be suspected with the first handshake. Of considerable importance is the apparent relationship of Bowen's disease with systemic cancer. Graham and Helwig (1959) found one-fourth of 155 patients with Bowen's disease had carcinoma of the respiratory, gastrointestinal, genitourinary, reticuloendothelial and endocrine systems as well as breast and eye malignancies. Hueper (1961) has stated that

arsenic is a recognizable carcinogen in the skin, lung and liver, and a suspected carcinogen in the mouth, esophagus, larynx and bladder.

Treatment of Bowen's disease should be undertaken as soon as the lesion is recognized, even though only 1 of 38 patients in Hugo and Conway's series (1967) had subsequent metastatic spread. Surgical excision or desiccation and curettage have high cure rates, but again (as with superficial basal cell carcinomas) topical chemotherapy is evolving as the primary treatment. This was first reported by Jansen and associates (1967), who treated 13 patients, 9 of whom cleared after one month of topical 5-Fluorouracil. Three of the failures had small areas retreated successfully. Bowenoid lesions occur on both the male and female genitalia, and the only treatment failure of this group was a patient with a vulvar lesion who developed severe edema necessitating discontinuing the drug.

Keratoacanthoma

Closely resembling the squamous cell cancer, both clinically and microscopically, is the keratoacanthoma, or self-healing epithelioma (fig. 6). An important characteristic is its rapid development, sometimes becoming an inch in diameter in only a month or two. It is a round, elevated, dome-shaped lesion with a keratotic or friable center. These occur especially as isolated tumors on the exposed areas of older persons and rarely are multiple. There is a tendency toward self-healing, but with the similarity to squamous cell cancer, the lesion should be excised or curetted and electrodesiccated. There is some tendency for the lesion to recur locally after treatment, especially on the fingers and lip areas (Rook et al., 1967).

Pigmented Lesions

In general, growths on the skin tend to increase in number with age. Many of them are common enough in younger age groups, but the frequency with which persons acquire most lesions and their multiplication favor the geriatric patient. An interesting exception is the true nevus, or mole.

Nevus-cell nevi, with the exception of the birthmark types, start occurring in infancy and numerically increase to reach a figure of 14 to 80 (average 40) between ages 25 and 35 (Stegmaier and Becker, 1960). They regress with time since Stegmaier (1959) found an average of 4 in 50 adults aged 50 and older. In the Duke Series 137 (84 percent) of the subjects had fewer than 10 nevi and only 5 (3 percent) had more than 20. The average of four per person agreed with Stegmaier. These nevi are predominantly dome-shaped intradermal nevi, the persistent ones tending to be located on the scalp, face and neck.

Malignant melanomas are difficult to pinpoint as to their origin for they can arise from normal appearing skin, pre-existing nevi, and from Hutchinson's malignant freckle. The vast majority of melanomas arise from preexisting pigmented lesions of some years duration (fig. 14) (McComb, 1965). It is important to

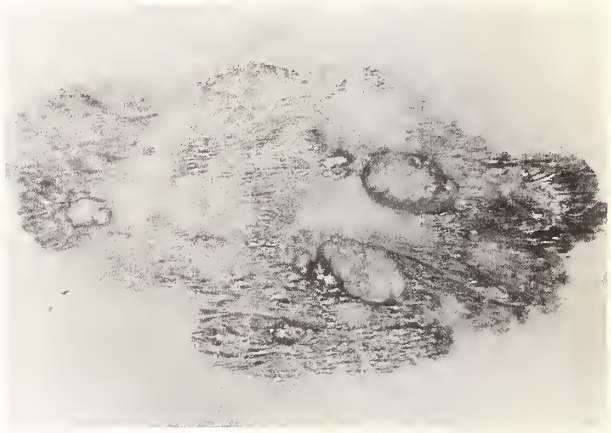

FIGURE 14.—A large malignant melanoma with varying degrees of pigmentation and growth.

point out that the peak incidence, determined by the heaviest statistical contributor in Block and Hartwell's series (1961) in Michigan, was in the seventh decade of life for both men and women. Hicks and associates (1955) consider the flat, active, junctional nevus in elderly people to have a very high malignant potential. Sunlight exposure together with fair complexion, appear to be the factors in reducing the age peak in Australia to the fifth decade (Lancaster and Nelson, 1957). In the Michigan series, lesions on the head and neck, which are exposed to the elements, had a far higher incidence than by chance alone (Block and Hartwell, 1961). These data agree with that of Allen and Spite (1954) and many others.

Therefore, it is necessary to inquire about all pigmented lesions for any change. New growths, especially with variations in pigmentation, with a tendency to bleed easily, increasing in size or showing small satellite lesions, should be removed and submitted for pathologic examination. Adequate treatment, consisting of wide excision, with or without regional lymphadenectomy, should be instituted as soon as possible.

Recent experience at Duke University Medical Center with melanoma revealed that 4 out of 5 persons presented themselves for treatment because the lesion *itched*. Surgery remains the treatment of choice.

The melanotic freckle of Hutchinson or *lentigo maligna*, referred to above, occurs almost solely in the latter half of life (fig. 15). It is a flat, macular or

FIGURE 15.—A superficial malignant melanoma of the sole, though most often on the face and neck (Hutchinson's freckle), can occur anywhere. Arrow points out areas of invasion into deeper tissues.

slightly raised, brown, blue or black lesion usually found on the face or neck (Jackson et al., 1966). The margin is irregular, and the lesion may increase in size to 3 or 4 inches in diameter over a period of years, though they usually are about one inch across. Wayte and Helwig (1968) reviewed 85 melanotic freckles histologically and felt that 45 contained a malignant melanoma at biopsy. Again, though other forms of treatment have been advocated, surgical excision appears best (Belisario, 1959).

Insofar as prophylactic removal of nevi is concerned, excision of those lesions under the beltline, brastraps, and other areas of trauma seems justified. However, in contradistinction to McComb (1965) and others, removal of pigmented lesions of the palms, soles and genitalia as a precautionary measure does not appear warranted because of their apparent lack of significance (Van Scott et al., 1957), and large numbers (Cullen, 1962).

Seborrheic Keratoses

Seborrheic keratoses are far more prevalent than nevi in elderly persons. An 88 percent incidence was found in the Duke series with over half the patients having 10 or more (fig. 13). They were the most frequent complaint in Noojin and Osment's series (1957) and the third most frequent in Lane and Rockwood's (1949). They range in size from pinhead to larger than an inch across, are raised and have a characteristic "warty" surface composed of many tiny fingerlike projections. In the areas of low sebaceous gland activity, they are dry and lighter in color; but in sebaceous areas, (face, neck and upper chest), they are greasy and dark. Between the projections, normal keratotic debris builds up, trapping the oily material which helps to give them their dark color. Unless traumatized, they do *not* show any erythema around the base.

The lesions are completely benign, though they can be confused with more important pigmented lesions. As they are raised above the skin level giving them a "stuck on" appearance, removing them superficially gives a very good cosmetic result. This can be done by "snipping" them off or curetting them and cauterizing the base; freezing them with dry ice or liquid nitrogen also is very satisfactory. When they are earlier and flatter lesions, olive oil or castor oil can be rubbed on as mild keratolytics and the lesion then slightly abraded off by the patient using a gauze pad. Seborrehic keratoses tend to increase in size and number with age but do not relate to any internal disorder (Tindall and Smith, 1963).

Senile sebaceous hyperplasia is the best term for the yellowish, soft, slightly umbilicated papules of 2 or 3 millimeters in diameter which occur on the face of persons past middle life. They are found most often on the forehead, are one to several in number, and entirely benign in nature. They are actually single, greatly enlarged sebaceous glands grouped around a wide sebaceous duct, the opening of which corresponds to the central umbilication. Lever (1967, p. 539) feels

the lesion represents a delayed organic nevus or hamartoma. They are of importance for two reasons—because they are cosmetically unsightly, and because they can be confused with small basal cell epitheliomas. Since they do not enlarge past 3 millimeters, never bleed or ulcerate without direct trauma, and have a characteristic appearance on close inspection, the aware physician can usually recognize them.

Lymphoma/Sarcoma Group of Special Interest

Though the incidence is relatively low, the gravity of the lymphomas and Kaposi's sarcoma requires that mention be made of these conditions.

One lymphoma is unique in that it always has its clinical onset in the skin mycosis fungoides (fig. 16).

FIGURE 16.—Mycosis fungoides in a 62-year-old man. The patient shows infiltrated areas and a large tumor on his left side.

The average age of onset is at the end of the 4th decade and early in the fifth decade (Bluefarb, 1959, p. 14).

The three variants of this disease are d'emblee, erythrodermic and classical. The d'emblee type presents with skin tumors whereas the erythrodermic type begins with red and inflammed skin and desquamation. The average duration of mycosis fungoides d'emblee is 3.24 years and that of the erythrodermic variety is 7.29 years (Bluefarb, 1959, p. 15).

The classical form is by far the largest group and has the longest duration—8.55 years (Bluefarb, 1959, p. 15). It begins as a non-specific, pruritic, dry skin-type problem or as a papulosquamous eruption (parapsoriasis). Initially, the disorder responds to ultra-violet light, tar ointments, lubrication and hydration. Gradually, the same areas become more infiltrated, finally leading to tumor formation. During the insidious progress of the disease, lymphadenopathy becomes clinically apparent. The lymph nodes, if biopsied early, are benign; but with time the transition to malignant lymphoma occurs. At autopsy, Block and associates (1963) found 82 percent of patients examined had visceral lymphomatous disease. The disease cannot be diagnosed microscopically until well after the practitioner, familiar with its manifestations, recognizes it for what it is. Once the true nature is known, systemic chemotherapeutic agents, systemic steroids, whole body electron beam radiation, and localized irradiation to tumors afford palliation.

Lymphosarcoma, rare after 70 years of age, and Hodgkin's disease, which tends to occur even earlier, will not be specifically discussed.

Kaposi's multiple idiopathic hemorrhagic sarcoma (fig. 17) has its greatest incidence in the sixth and

FIGURE 17.—Kaposi's sarcoma in its classical location. The lesions are purplish in color.

seventh decades—50 percent of all cases in one series occurred during these two decades (Dorffel, 1932). While mycosis fungoides favor men about 2 to 1, Kaposi's sarcoma affects men in a ratio of about 9 to 1 (Bluefarb, 1957, p. 8). The skin is the most frequent site of predilection in Kaposi's sarcoma, the lower and upper extremities being most frequently involved (75–85 percent of cases) (Bluefarb, 1957, p. 17). No cutaneous surface is exempt, however. The next most frequent sites of involvement are the submucosa of the entire gastrointestinal tract, the external genitalia, the superficial and deep lymph nodes (especially the retroperitoneal and mesenteric nodes), liver, and lungs. Less common areas are the tonsils, bones, larynx and conjunctivae (Bluefarb, 1957, p. 17). Lever (1967, p. 659) has summarized the evidence favoring the autochthonous rather than metastatic origin of the lesions as: (1) there is no primary focus that enlarges progressively; (2) some lesions regress spontaneously; and (3) histologic examination may reveal very early stages in late appearing lesions. He concludes that Kaposi's sarcoma does not represent a sarcoma primarily. The most widely held view is that Kaposi's sarcoma is a benign angiomatosis arising from immature, pluripotential vascular cells. Death can be attributed to Kaposi's sarcoma in only 10–20 percent of those affected (Cox and Helwig, 1959). Another unusual feature is that there appears to be a higher than expected association with lymphomas (Brunning et al., 1963; Cox and Helwig, 1959). The tumor is relatively radiosensitive, and there is general agreement that various modalities for delivery of irradiation is the treatment of choice (Bluefarb, 1957, p. 140).

Blistering Diseases

Herpes zoster, hereafter referred to simply as zoster, is one of the scourges of older life (fig. 18). Zoster has two clinical components, the lesions of the skin, mucous membrane, or eye, and the symptoms from nerve involvement (Blank and Rake, 1955, p. 75). The skin lesions typically involve one or more dermatomes or sensory nerve distributions, and are characterized by groups of vesicles on erythematous bases along the path of the nerve. In 4 percent or more of patients with zoster, isolated vesicular lesions appear scattered over the body (Blank and Rake, 1955, p. 75). Thoracic sites are found in 56 percent of patients, with trigeminal and cervical involvement accounting for 10 percent and 12 percent respectively (Kass et al., 1952). Incidence in the Duke Series by history was 12 of 163

FIGURE 18.—Herpes zoster involving the ophthalmic branch of the trigeminal nerve. The arrow points out a crusted lesion on the tip of the nose. The patient had corneal involvement.

(7 percent), with all patients relating a previous history of chickenpox. Of the remainder of patients, 105 had a history of chickenpox but no zoster, and 46 had neither. The viral particles have identical morphologic characteristics in both chickenpox and zoster (Blank and Rake, 1955, p. 87), and the evidence is sufficient to consider them as different clinical manifestations of infection with the same virus (Blank and Rake, 1955, p. 71).

Hope-Simpson (1967) reported that persons 70 and over are 5 times more likely to suffer an attack of zoster in any one year than middle-aged persons. One or 2 out of every 100 of the elderly will have shingles in a single year. In addition to age, there is an increased incidence of zoster in patients with chronic leukemia, lymphoma or myeloma (24 of 303 patients—7.9 percent in one series) (Shanbrom et al., 1960). Blue-

farb (1959, p. 282) gives an incidence of 4–7 percent in Hodgkin's disease and lymphosarcoma, and an incidence of 1 percent in lymphatic leukemia.

There are 2 complications which deserve special note. The first is involvement of the eye. In zoster of the ophthalmic branch of the trigeminal nerve, the cornea is often involved, the incidence approaching 100 percent when the tip of the nose (nasociliary branch) is part of the cutaneous eruption. The other complication is post-herpetic neuralgia. The pain of zoster may be superficial and/or deep—sharp, dull, stabbing, and burning—and once the pain pattern has existed for a time, it becomes imprinted at a high level in the central nervous system, much like the phantom limb syndrome. The pain and discomfort tend to dwindle over months and years but sometimes persist for the remainder of the patient's life.

Treatment has not been uniformly successful though many drugs and methods have been used. It appears clear that the pain *must* be controlled during the acute phase, even using opiates, in an effort to lessen any post-herpetic neuralgia (Hope-Simpson, 1967). Systemic steroids in decreasing doses are felt by many to be of help in reducing both inflammation and pain, while they do not appear to disseminate the zoster. Other methods, such as protamide, have many advocates but the true value is not proven. Hope-Simpson (1967) points out that zoster, like influenza and infectious hepatitis, is intrinsically mentally depressing, necessitating appropriate medications and physician support.

Bullous diseases are frequently of great importance since some of them are life threatening. The bullous disease of the aged, bullous pemphigoid, and dermatitis herpetiformis (D.H.) as a group rank high in the geriatric population according to Welton and Greenberg's survey (1961). Both disorders are characterized by blisters occurring at the junction between the dermis and epidermis. Bullous pemphigoid (fig. 19) is far more dangerous since it is sometimes associated with internal malignancy, and even when it is not, large doses of systemic steroids are required to control the eruption so that the patient will not become debilitated from the disease. On the other hand, dermatitis herpetiformis is a chronic disorder and is characterized by pruritus, sometimes so severe that it is difficult to find blisters as they are scratched away almost before they become clinically evident. Treatment with sulfapyridine is specific and highly effective, though few patients can be taken off the drug.

FIGURE 19.—Bullous pemphigoid in a 75-year-old man.

Due to the difficulty of establishing the correct diagnosis on purely clinical grounds and because of newer research findings and therapeutic approaches, it is recommended that patients with bullous diseases always be referred to a dermatologist.

Vascular Problems

Stasis dermatitis and ulceration is one of the great problems involving the lower legs (fig. 20). It is like the clearing of muddy water from a slowly moving stream compared to a more rapidly moving one. The poor venous return impedes the normal function of the circulation, and small areas of trauma too often result in large and refractory ulcerations (fig. 21). The dermatitis itself reflects a certain degree of incompetence, becomes wet and exudative, and sometimes builds up considerable debris. Compresses with one-fourth percent acetic acid and gently scraping off this debris effects marked improvement when done with diuresis

FIGURE 20.—Marked accumulation of debris in a patient with stasis dermatitis.

FIGURE 21.—Stasis ulcers, such as this, must be cleaned up before healing can be expected.

and some elevation of the legs to get gravity to help rather than hinder. Then a local steroid ointment following hydration will often allow good control of the process. Supportive hose for those with varicose veins, essential in many patients, allow for polyethylene inclusion of the ointment during the day when activity is great. The polyethylene will also obviate some of the irritation of the hose by separating them from the skin.

A stasis ulcer requires more vigorous treatment. Good nutrition and vitamin supplements are essential (Kopjas, 1968). Compresses will help to clean up the ulcer, aided by proteolytic enzyme therapy (Spencer, 1967). Recently there has been renewed interest in the use of oral zinc sulfate in the healing time of leg ulcers (Husain, 1969), but in this country it is not an approved drug. Topical application of gold leaf appears to stimulate granulation tissue, and is convenient and cheap (art supply stores), but must be used on clean wounds (Chick, 1969; Kanof, 1964). At times, tetracycline, 250 mgm. twice daily, will accomplish this when other methods alone will not. Many patients have healing effected only to break down the skin again; so that any varicose veins, provided the deep venous circulation is competent, should be ligated and stripped, with (Butcher, 1955) and without (Arnoldi and Lindahl, 1967) grafting of the ulcer at the time of surgery. In the latter survey, patients with normal deep veins had a 2.9 percent recurrence rate of ulceration, while the post-thrombotic legs had a 15-percent recurrence. Without doubt, old ulcers become fibrotic and *must* be excised before a split thickness graft or pedicle flap can be used to heal the area (Greeley, 1953).

Decubitus ulcers, everyone agrees, are much better prevented than cured (Merlin, 1969). The patient must not be allowed to break down an area when frequent turning and good hydration-lubrication skin care can prevent it. Proteolytic enzymes and local antibacterial

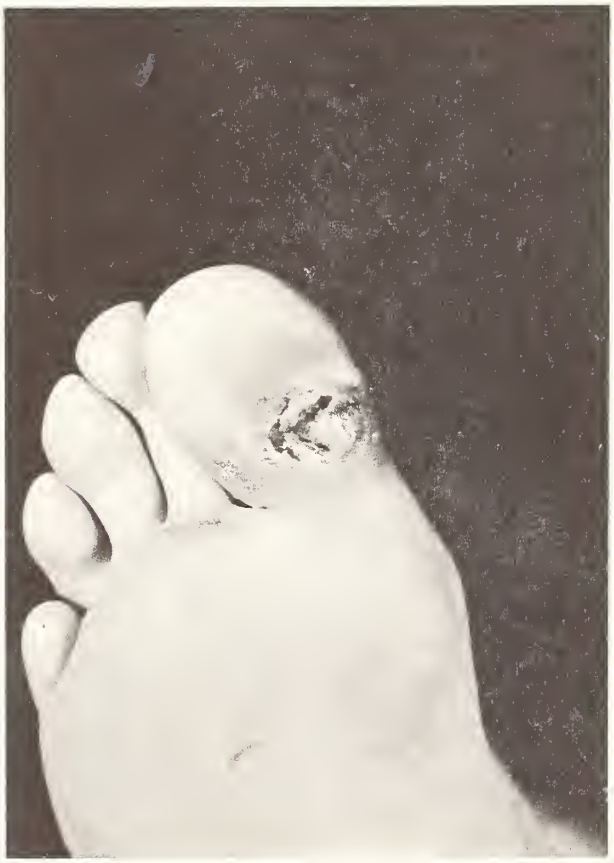

FIGURE 22.—Trophic ulcer in a diabetic patient.

agents have been used with some success. Alternating pressure mattresses and, if available, flotation using a vinyl bladder filled with water (Harris, 1967) help to prevent and heal the pressure sores.

Leg ulcers make up a huge list for differential diagnosis (Callaway, 1963) and entire books such as the one by Piulachs (1956) have been devoted to the subject. Diabetic and neurotrophic ulcers (fig. 22) (Pomeranz and King, 1965) are best treated without compresses, which often seem to extend the lesions except when used for hydration before careful mechanical debriding. Topical oxygen has been helpful in venous as well as ischemic ulcers and has advocates (Fischer, 1969). The suppression of bacterial overgrowth may be its most important action in venous ulcers (McFarlane, 1965). Finally, foot and heel ulcers are essentially small decubiti and must have pressure removed for healing to take place (Steinberg, 1965).

Special Problems Related to Itching

Some mention has already been made concerning the tendency of aged skin to dehydrate and chap more easily than the skin of younger persons. The specific entity, commonly called "winter itch," asteatosis, or dermatitis hiemalis, is seen with regular frequency. In the Duke Series, 77 percent of those examined had sufficient evidence of dryness to be so designated. Of interest, the subjects were examined during the 7 coolest months of the year. Some situations aggravate the condition, particularly the alkalinizing effects of soap (Grais, 1953). Soap substitutes, either high in fat content or a colloid fraction of oatmeal, is preferred for washing. Bath oils in this age group are too dangerous for use since they make the bathtub extremely slippery. Instead, application of an oil to the skin still wet from the bath is much preferred. To be kept in mind is the clinical effect of "drying" of patients' skins while receiving hypocholesteremic drugs, which either inhibit cholesterol biosynthesis or promote excretion of lipids or their metabolites (Roe, 1966).

In dealing with bedridden patients, the report of Lawrence and Silverman (1966) is especially worthy of note. They studied, in a controlled fashion, the effects of impregnation of laundered linens with a chemical antiseptic, with and without antiseptic skin care products. The groups so treated differed significantly from the untreated controls in the curbing of such problems as ammoniacal or perianal dermatitis, intertrigo, secondary bacterial infections and the development of decubiti. The antiseptic used employed the quaternary nitrogen radical.

Itching, so great a problem in dermatitis hiemalis, can be associated with conditions of far greater importance than the discomfort itself. Cormia (1965) described some patients with prolonged, variably severe pruritus secondary to underlying malignancies. The differential diagnosis must include diabetes mellitus, advanced liver or kidney disease, thyroid dysfunction, polycythemia vera, gout, and the results from a variety of drugs. The itching associated with malignancy can be seen associated with a wide variety of carcinomas, but the lymphoma-leukemia group ranks highest of all. At times the patient develops a true exfoliation of his skin (fig. 23) with associated malignancies as just described.

Itching of a more localized or discrete nature would include lichen simplex chronicus (localized neurodermatitis), a relatively common malady in older persons occurring especially around the ankles and on the posterior neck. Also, one sees neurogenic excoriations. In the Duke series, 12 percent had the small excoriated,

FIGURE 23.—Generalized dermatitis with marked exfoliation of the skin presents a diagnostic and a therapeutic problem.

"picked" areas, especially on the most accessible areas of arms, legs and face. Drugs such as morphine and the amphetamines provide sensations culminating with these lesions. Such serious psychological reactions as delusions of parasitosis sometimes occur. Wilson (1952) indicated that these patients should be classified in one or another of 4 psychiatric categories: toxic psychosis, the paranoid type of dementia praecox, involutional melancholia, and paranoia. They are very difficult therapeutic problems with a poor prognosis for recovery.

Vaccine Reactions

Some of the problems of vaccination against smallpox have received recent attention. Arguments relating to the threat of a smallpox epidemic, its relevance in our society at the present time, and the hazards of the vaccination itself are thought provoking regardless of the age group of one's interest. The complications of vaccination in 1968 have been reported, and revealed that 68 percent of the patients were primary vaccinees, 7 percent were revaccinees, 20 percent acquired vaccinia not by vaccination but by contact, and 5 percent had unknown histories of vaccinations (Lane et al., 1969). According to Lane and Millar (1969), 22.8 percent of the population of the United States over the age of 64 years had never been vaccinated (1967). At least 7 deaths per year are recorded each year attributable to vaccinia infections.

Treatment for untoward reactions with either vaccinia immune globulin (VIG) and thiosemicarbazones is available in most instances and is of definite benefit (Lane and Millar, 1969). But to discontinue the present control of smallpox by vaccination would seem imprudent. During the past 15 years in which the United States has been free of smallpox, importations into Europe have resulted in 723 cases, with 111 fatalities. Commenting further, Katz and Krugman (1969) feel that an accelerated effort to develop improved vaccines, while continuing to be aware of the contraindications to the present vaccine, are the most reasonable guidelines.

An increasing number of elderly citizens are finding opportunities to travel about the world, many of them to endemic areas. Severe reactions occur too often when there is an underlying lymphoma or leukemia. Persons with innate immune deficiencies, eczemas and generalized dermatitides, and those receiving drugs which have immunosuppressive effects (including corticosteroids) are candidates for severe complications. Few persons over 65 years of age have kept up their immunity to smallpox properly with revaccination every 5 to 7 years. The physician, therefore, should be especially careful in dealing with vaccinations in elderly persons.

Another area of immunity is also coming under scrutiny. A recent death in North Carolina from tetanus of an unimmunized 65-year-old man emphasizes the importance of one's immunity to this often fatal infection (North Carolina Board of Health, 1969). Most people in the United States have received a basic sries of tetanus immunization, but boosters are notoriously neglected. Peebles and associates (1969) have reported their reappraisal based on an analysis of available data. They found a confidence level of 99.9 percent for protection 12 years after the last injection in those individuals who have received 4 or more injections of toxoid. Since boosters after the basic series are not necessary except every 12 years, prevention of fatal tetanus infections seems quite easy, pro-

vided that the physician helps his patients follow the limits of safety.

Syphilis

The diagnosis of syphilis in the geriatric patient can present a whole spectrum of problems from the difficulty of demonstrating the spirochete, Treponema pallidum, to the complexity of the serologic tests available today. Like so many disorders predominately found in younger persons, a level of suspicion for the manifestations of the disease is necessary. In one New York City hospital, out of 210 patients with early syphilis, 5.2 percent were patients over 60 years of age (Young and Sun, 1965).

Diagnosis by darkfield examination of material taken from a suspected lesion or aspirated from an enlarged regional lymph node is highly reliable in the hands of trained personnel. The material can be collected in a capillary tube, sealed on both ends to prevent drying, and forwarded to a State laboratory if a darkfield examination is not immediately available.

There are two groups of blood tests for syphilis readily available: the nontreponemal and the treponemal tests. The nontreponemal, or serologic tests for syphilis, employ a variety of techniques for demonstrating reagin, a globulin complex of high molecular weight. Since Wasserman's original test, the specificity and sensitivity of these STS tests have improved greatly, but are used primarily for screening of patients. The treponemal tests, employing actual treponemal antigens, are more specific than the screening tests, but are more expensive to perform. Of these, the fluorescent treponemal antibody absorption (FTA-Abs.) test has evolved as the best overall test, particularly in extremely early syphilis and in syphilis of long duration (Nicholas, 1967; Nicholas and Lentz, 1968).

There are 3 problem situations where accurate diagnosis is especially difficult: the sero-nonreactor with signs of early syphilis; the seroreactor with neither signs nor symptoms of syphilis, possible biologic false positive (B.F.P.) reactors; and the sero-nonreactor with signs of late syphilis. The specific treponemal tests are of great help in evaluating these problems. The Reiter protein complement fixation test (RPCF) and the Kolmer test with Reiter protein (KRP) are now obsolete, and the technical difficulties and expense of the T. pallidum immobilization (TPI) test have lessened its practical importance in favor of the FTA-Abs. test (Nicholas and Lentz, 1968).

The biologic false positive phenomena has been studied in elderly men. Among 259 predominately elderly male patients with a positive STS, 162 had negative TPI tests and were therefore regarded as B.F.P. reactors. An increased incidence of collagen-vascular disease was not found in the elderly B.F.P. reactors. As a venereal history was not found helpful in differentiating the B.F.P. group from the latent luetic group, the only way the patients could be separated into their appropriate groups was with the aid of a specific treponemal antigen test (Carr et al., 1966).

Treatment of early syphilis can most adequately and conveniently be administered as a long-acting intramuscular penicillin, 2.4 million units, in 2 doses interspaced by about 5 days. For late syphilis, procaine penicillin, 600,000 units daily for 10 days is optimal. Should the patient be allergic to penicillin, erythromycin would be the antibiotic of choice, using 1 gram daily for 20 days in divided doses.

CONCLUSION

The skin problems of geriatric patients are not problems simply confined to their older age group. First of all, there are banal lesions which increase in numbers with time, their principal importance being only to recognize them for what they are or are not. Changes of the skin, physiologically and biochemically, predispose the old skin to the development of special kinds of problems and alter the ability of the skin to cope satisfactorily with the environment. In particular, the ravages of chronic sunshine exposure have a pronounced effect. Also, the skin gradually loses its ability to heal as well as before, with the result that minor trauma can become a major problem, and eczematous problems become chronic eczemas with considerable discomfort. In a sense, aging skin would appear to be like a race to see if the new growths can win before atrophy cancels the entire event.

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SECTION A/DISEASES AND DISORDERS MOST RELEVANT TO SINGLE ORGAN SYSTEMS

Part II/The Major Organs of Special Sense and Communication

EYE PROBLEMS OF THE AGED

By

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One of the tragic aspects of growing old is to experience gradual diminution of the five senses. This particularly pertains to vision, since the ability to see is so important for the pursuit of pleasure in old age. Loss of vision can greatly reduce—or prevent—the pleasures which stem from travel, shopping, visiting, reading, or watching television. Thus, preserving an elderly individual's vision helps to preserve his major sources of happiness in later life. The following discussion focuses on measures that can be taken to assist in this.

This manuscript is based on a study of 912 patients (Gordon, 1961–a, 1961–b) seen in practice, plus a study of 1,018 residents of a home for the aged (Kornzweig et al., 1967; Feldstein et al., 1959; Kornzweig, 1964). The findings in these two studies were in close agreement. Age 65 was chosen as a convenient starting point because it is the age now usually specified as the time for retirement.

Legal blindness in this country is defined as vision of 20/200 or less in the best eye, or a visual field of 20 degrees or less in diameter in the best eye. 20/200 is the amount of vision necessary to see the big "E" on the chart at 20 feet. A field of 20 degrees in diameter would permit one to see (with that one eye) a person's nose and ear at the same time, and would provide for poor to mediocre ability to walk about. Two essentially similar eyes would make for some visual reinforcement, and consequently an expanded field.

Theoretically and practically, the eye is so constructed that it can normally be expected to function efficiently (Rones, 1938; Kornzweig et al., 1957) even beyond its owner's lifetime. Histologic studies of eyes taken from the aged at autopsy revealed normal findings in over half.

It is an interesting fact that most senior citizens have fair to excellent vision. In general, an individual whose best (corrected with glasses) vision is 20/50 or better, rarely has much problem either in outside life or reading. The individual with 20/70 vision falls into the gray area for near vision, although he has little if any problem in navigation if his field is adequate. The individual with but 20/200 usually has a real problem in reading, recognizing faces, etc. He often can be enabled to read with magnification and a good light set close to the reading material; but the older and feebler and less cooperative he is, the more difficult it becomes to aid him in this manner. Approximately 67 percent of a group of 912 patients of 65 and over had vision of 20/30 to 20/15 in the better of their two eyes, 11 percent had vision of 20/40 in the better eye, and an additional 6 percent had vision of 20/50 to 20/200. Approximately 4.5 percent had vision of 20/200 in the better eye and 10 percent had vision of less than this amount. Kornzweig, Feldstein and Schneider (1957) who reported on a group of 1,018 patients of this same age group, residents of a home for the aged, and in whom the findings were comparable, found that 86.1 percent of their patients had vision of 15/70 to 20/15 in the better eye.

Of all geriatric ocular problems, the 3 most common are macular disease, cataracts, and glaucoma. Macular disease accounts for about 45 percent of eye problems in the aged, cataracts about 33 percent, and glaucoma about 5 percent. Harrison and Wolf (1964) found an incidence of 13 percent of glaucoma in a series of 107 men aged 74 to 92. In the groups studied by Gordon (1962) and by Kornzweig (1964), many patients were found to have 2 or more of the following conditions:

cataracts, macular disease, vascular changes, diabetic retinopathy, and glaucoma.

CATARACTS

A cataract is an opacity of the lens which, if it is situated at or near the center of the lens, impairs vision. Throughout a person's life, the lens grows by laying down new fibers. Simultaneously, there is a compensatory shrinkage or drying of its nucleus, which keeps it from becoming so large as to fill up the entire globe and which causes artificial myopia so that the patient may temporarily be able to read better than before with glasses. At the same time, the lens capsule thickens and becomes less permeable. This progresses with age to a state where the nucleus is too hard and dry to transmit light efficiently. Cataractaceous (Feldstein et al., 1959) changes may occur in any portion of the lens, including the cortex, nucleus, and subcapsular areas.

Probably everyone would acquire cataracts if he lived long enough, even though the age of onset varies widely in different individuals and families. Technically, every lens opacity is a cataract, but the condition becomes a surgical problem only when it interferes with useful vision.

We are all familiar with the case of the grandmother whose vision had been poor and then suddenly became good enough for her to read again. This so-called "second sight" is usually due to increased sclerosis (drying) of the lens nucleus, which produces an artificial myopia. During this period she may even be able to read without glasses. If she dies before the sclerosis progresses to the point of opacification, she and her family may never know that she had had a cataract. Often, however, her vision will fail again and not return until the diseased lens is removed.

When a patient has a cataract so advanced that one can not evaluate the retina because of the opacity, it probably should be removed, especially if the patient can identify colored lights and the direction from which a beam of light is projected. Even if the patient does have a diseased macula, removing the cataract may give better peripheral vision, which facilitates ambulation.

If a cataract is removed and a macular lesion is then discovered, central vision will be markedly impaired, but may be facilitated by the use of low vision aids. When there is a central corneal scar and a cataract is to be removed, the ophthalmologist will attempt to create a new pupil around the scar. When surgery is not feasible, or the cataract is not dense enough for surgery, vision may be improved by dilating the pupil during the working hours. This can be done even in the presence of an open angle glaucoma, but should not be done if the anterior chamber angle is narrow.

When open angle glaucoma and a central lens opacity coexist, the ophthalmologist may be able to improve vision by dilating the pupil during part of the day.

However, the ophthalmologist may hesitate to remove an advanced cataract in one eye when the patient has useful vision in the other. This is because an eye from which a lens has been removed cannot function in teamwork with the other eye with ordinary spectacles. The only accessory artificial lens that will permit the operated eye to function in binocular single vision with the unoperated eye is a contact glass, and it is difficult to get older people to go to the "trouble" of learning how to use contact lenses. Most patients with one "good" eye are content, visually.

On the other hand, many ophthalmologists will advise the elderly patient with two advanced cataracts to have only one removed, since this should suffice to give him useful vision. Theoretically, this is good reasoning, but in practice the patient often resents the blur caused by his unoperated eye and will later ask to have the other eye operated also. Technical advances in cataract surgery have reduced the incidence of complications and render this a comparatively easy type of operation for the aged or infirm patient to undergo. He no longer is required to undergo the period of immediate postoperative immobilization required years ago.

Since aging is accompanied by an increasing degree of sclerosis of the pupil sphincter and decreasing size of the pupillary aperture, plus an increasing amount of lens opacity, the older person is often handicapped by a situation which prevents an adequate amount of light from entering his eye (decreased aperture plus lens opacity) at the very time in life when he requires more light to compensate for the lens opacity and other ocular pathology which may be present.

If an aged person must lose vision, it is preferable to lose it on the basis of cataracts than from most any other cause. This is because a successful lens extraction, in face of an essentially normal retina, restores a gratifying amount of vision. The new plastic lenses make for more comfortable spectacles, are light in weight, and permit a good field of vision. Nevertheless,

many people are frightened at the idea of developing cataracts. The reason for this is unclear, unless it is because subconsciously "cataract" sounds like "cancer," which it does not remotely resemble.

SENILE MACULAR DEGENERATIONS

The so-called "senile macular degenerations" usually affect both eyes ultimately and are probably secondary to some vascular change. The macula can justly be called the center of retinal vision. It perceives fine detail such as print and recognition of faces. When choroidal sclerosis affects the macular region, there may be a dramatic loss of central vision.

The various diseases and degenerations of the macula are progressive. When they are inflammatory, they may respond to systemic and subconjunctival administration of the various corticosteroids, which often mitigate macular scarring when employed early and intensively. Some patients with senile macular degeneration without any inflammatory component have responded to systemic corticosteroids. There is doubt that the drugs have any effect in the degenerative condition; they probably function by removing fluid from the diseased retina. Regardless of their mechanism of action, they should be given a trial of a month or two in patients with macular degeneration.

With advancing age, sclerosis (Rones 1938) and atrophy of the retinal neuroepithelium occur. Cystic changes in the peripheral retina may lead to formation of holes, which often are harmless, but which can produce a retinal detachment. Hole formation and retinal detachments are more common in myopia. There is a form of high myopia, known as myopia gravis, which is associated with macular degeneration, hemorrhage, and consequent grave loss of vision.

The central blindness produced by diseases of the macula, characterized by the loss of the ability to read or to make out detail, is a benign type of blindness. When sclerotic changes affect the mid and far periphery primarily, the effect is more serious, for then the patient has "tunnel vision," which may be so extreme as to make it impossible for him to see the eyes or ears of a person's face when he is looking at that person's nose. This is serious because it markedly impairs his ability to walk around and deprives him of his side vision protection against autos, other pedestrians, etc.

Older patients may be helped by the simple suggestion that they use one of an increasing variety of low vision aids. These magnifying devices, which are used either as hand-held magnifiers or incorporated into spectacle lenses, make the lives of many elderly patients fuller by enabling them to read. Most patients prefer hand-held magnifiers, which should be as weak as possible. Many patients benefit by a +4 or +5 added in the bifocal.

Retinal and choroidal vessels undergo atherosclerosis, usually mild and insignificant, but when this condition progresses sufficiently, vision is impaired. The sclerosed choroidal vessels are visible ophthalmoscopically as broad, flat, white lines lying deep to the vessels of the retina. Excrescences form on Bruch's membrane between the retinal and choroidal vessels. Through the ophthalmoscope these appear as drusen or colloid bodies—scattered, round, white spots usually most prevalent about the macula. While they rarely disturb vision, they may herald macular degeneration. Ophthalmoscopically, it is usually impossible to predict their effect on vision.

With advancing age, *gliosis* and *atrophy* of the nervous elements occur. The retina exhibits glistening silky reflexes in the young, but these disappear with advanced age when the fundus exhibits less luster.

The retinal arteries become narrower, straighter, more irregular in caliber, and more opaque. As sclerosis progresses, arteriovenous compressions and deflections may cause pathologic vascular changes, such as major and minor venous and arterial occlusions. The incidence of diabetic and hypertensive retinopathy increases as these diseases advance. Diabetes exerts a deleterious effect on other retinopathies and lens changes.

The older that one becomes, the more liable he is to develop systemic diseases and their ocular changes.

CHANGES IN MAJOR BLOOD VESSELS

Occlusion of the Central Artery or Its Branches

The first symptom of arterial occlusion is obscuration of vision by a sudden fog which is then followed by the sensation of seeing varicolored lights followed by loss of light perception. In those in whom the occlusion of the artery is incomplete, some light perception, or even better vision, may remain in that field in which there is still a somewhat patent artery. In a small percentage, because the occlusion is not complete, there will be a gradual restoration of some vision. This may occur spontaneously or following treatment, and at times treatment may be given credit when the restitution would have occurred spontaneously.

When the eye is viewed through the ophthalmoscope, the retinal arteries are markedly narrowed and may be virtually invisible, or they may be visible for only a short distance from the disc and then suddenly seem to disappear. At times there will be accompanying white lines about the arteries. Where the arterial blood column is visible it may be darker and, therefore, almost indistinguishable from the accompanying veins.

Pressure on the globe will not produce arterial or venous pulsation on the pale disc. Inability to produce arterial pressure definitely suggests an occluded artery. In some of the vessels there is "trucking," which is a term applied to a segmented appearance of the blood columns in the vessels. The appearance is that of a line of red boxcars which at times can be seen to move back and forward.

A short time after the occlusion of the central artery, the characteristic edema of the perimacular area occurs. Since the foveal region and macula are thinner than the surrounding retina, the normal red color of the choroid can best be seen here while it is obscured by the opaqueness of the "thicker retina" which surrounds the macula. As a result, a so-called "cherry red spot" is seen. Edema occurs in the inner layers of the retina; since these layers are normally absent in the foveal region, it is not involved in the edema. This is a contrast phenomenon, the greater the white opaqueness of the surrounding area, the more prominent the "cherry red spot."

Occlusion of the central artery or one of its branches is an essentially bloodless phenomenon; hence hemorrhages are not a normal part of the clinical picture, although occasionally a rare hemorrhage may occur. However, when there are many hemorrhages present in a quadrant of the retina, one can assume that there is an occlusion of that branch of the central vein. Over a period of time, the opaqueness and its accompanying "cherry red spot" disappear leaving an atrophic retina with fine narrow arteries.

In incomplete occlusions, the loss of vision is appreciably greater in the more involved quadrants. If the circulation improves spontaneously, or as the result of treatment, the return of vision may be complete. Vascular occlusions may be preceded by transitory losses of vision occurring and recurring over a matter of days to months to years. Today we know that patients complaining of such incidents should be examined with the ophthalmodynamometer. When positive signs pointing to occlusion are found, treatment with anticoagulants is definitely indicated and may prevent occlusion of the central retinal vessels as well as occlusive phenomena in other parts of the brain.

Treatment

The results of treatment depend upon whether the etiologic mechanism is embolic, thrombotic or spastic. If due to embolus or spasm, sudden lowering of the intraocular pressure, plus simultaneous use of a vasodilator as amyl nitrate, may prove valuable. Oxygen inhalations are of temporary value while given. The value of the fibrinolytic agents in arterial or venous occlusions is still to be delineated.

Occlusion of the Central Retinal Vein or Its Branches

Obstruction of the central retinal vein does not cause as abrupt a loss of vision as occlusion of the artery. The amount depends upon the degree of obstruction, and may vary from almost complete loss with retention only of light perception to perception of hand movements or better. Unlike incomplete arterial occlusion, there is always retention of at least light perception or better vision. As in arterial obstruction, vision may improve after a time, or if complications such as secondary glaucoma set in, vision may be lost completely.

The ophthalmoscopic picture contrasts markedly with that of obstruction of the central artery. The picture is a hemorrhagic one, with all quadrants spattered with hemorrhages, transudates and edema. The veins are engorged and thrown into tortuous snake-like red bands. The arteries are narrowed and difficult to distinguish. When pressure is made upon the globe, there is no resultant collapse of the veins and induced arterial pulsation as would be exhibited normally. Vitreous hemorrhages may occur occasionally. The disc may be almost invisible in the face of the massive edema and hemorrhages. The less the obstruction, the less the edema and the fewer the hemorrhages and transudates, and the less the impairment of vision and visual field.

The ophthalmoscopic findings may not fit the visual findings recorded, in that normal vision may be elicited in the presence of an apparently massive retinal vein occlusion. These incomplete occlusions are the patients who make the most dramatic responses to therapy or who improve spontaneously.

When the obstruction is limited to one main branch of the vein, such as the papillary vein or a quadrant

vein, the loss of vision and the hemorrhagic picture tend to be quadrantic. When the superior temporal vein is obstructed, the ensuing retinopathy may spill down and so involve the macula that central vision may be impaired markedly. When branch occlusion occurs, it is the superior temporal vein which is most commonly involved.

Treatment

The customary treatment for occlusive venous disease is anticoagulant therapy administered by someone competent in its use. There is considerable disagreement as to its merit in ophthalmological circles; about half on one side, half on the other. This author favors therapy. Systemic steroids, 6–10 tablets daily (i.e. 0.5 to 1.5 mg. dexamethasone qid, 10–15 mg. prednisolone, tid to qid, etc.) should also be given a fair trial for several days in the event that an inflammatory mechanism is present.

Vitreous Hemorrhage

The sudden occurrence of a massive vitreous hemorrhage may produce a complete or almost complete loss of vision. The patient may first see a number of sparks or spots followed by a rapidly increasing fog which obliterates the vision and gives him the sensation that that eye is closed. When the hemorrhage is massive, the normal red reflex is replaced by black; when less complete, the red reflex is replaced by varying degrees of black.

Commonly, vitreous hemorrhages are associated with retinal detachments and hence every massive vitreous hemorrhage must be assumed to be covering a retinal detachment. They also occur in diabetes, choroiditis or periphlebitis. Many vitreous hemorrhages will tend to clear after a matter of days to weeks, or they may require a year or a year and a half before appreciable clearing takes place. There are some in whom this never occurs.

The patient should be put to bed in a sitting position with both eyes bandaged overnight, and then with as little eye motion as possible, the eye should be examined with an ophthalmoscope, in the hope that there will be sufficient temporary settling of the blood so that the retina can be viewed through the dilated pupil. The patient's activity should be markedly restricted until the diagnosis of retinal detachment can be made or excluded.

If the coal black reflex persists for an appreciable period of time, it becomes impossible to limit the patient's mobility, and he can then be permitted to go about his normal activities under observation, with frequent ophthalmoscopic examinations. A "confrontation field" using one's fingers or a similar large target may reveal a defect in the field, presumably pointing at the detachment or other lesion.

Treatment

There is no specific treatment for massive vitreous hemorrhage other than temporary bed rest with bilateral occlusion plus dilation of the pupil on the involved side. Attempts to promote absorption of the blood by use of artificial fever, oral trypsin, streptokinase and streptodornase, and other means have proved uniformly unsuccessful, but still merit trial if only for placebo effect. Patients resent "non-therapy" and feel neglected. Because of the high incidence and rapidity of spontaneous absorption, many therapies have been given unearned recognition.

Retinal Hemorrhages

Retinal hemorrhages either when they involve the macula or when in profusion outside the macula or when great in size will cause blind areas which move in direct relationship with movement of the eye, and are usually noted by the patient. The two diseases in which retinal hemorrhages occur most commonly are diabetes and hypertension, but they may occur in a variety of other conditions including retinal periphlebitis and the various hemoglobinopathies such as sickle cell disease, macroglobulinemia, leukemia, etc. The treatment is directed at the causative disease.

Temporal Arteritis (Cranial Arteritis Syndrome)

This condition is undoubtedly part of a generalized arteritis though symptoms from it when in full-blown stage, consist of painful inflammation of the temporal artery with persistently low-grade fever, severe headaches and constitutional symptoms often including prostration. It is usually unilateral although it may eventually become bilateral, affects the 50 to 80-year-old age group, and more commonly affects women.

The ocular symptoms which occur in approximately half of these patients are those of loss of vision on the basis of an ischemic optic neuropathy (with a pale, blurred optic disc) or occlusion of the central retinal artery. Transient or permanent loss of vision may occur without other obvious symptoms of temporal arteritis. In loss of vision on an obscure basis, espe-

cially in an elderly person, the diagnosis of temporal arteritis must always be kept in mind.

When the temporal arteries are palpated, they are often found to be cord-like in consistency and roll under the examining fingers. A biopsy of the artery confirms the diagnosis, especially when a granulomatous arteritis with giant cells of Langhans and narrowed arterial lumen often containing a thrombus are found. The sedimentation rate is elevated during the acute phase of the disease.

Treatment

Approximately one-third of the affected eyes tend to become blind. Large doses of corticosteroids beneficially affect the vision as well as the pain. The efficiency of the systemic steroids is definitely related to the speed with which they are administered before visual symptoms occur, and to the dosage which must be very high initially.

One should start treatment with a minimum of 8–10 full tablets of steroids daily (i.e. 40–50 mg. prednisone, 4.0–6.0 mg, dexamethanone, 4.8–6.0 mg. betamethasone, 32–40 mg. methylprednisolone or 16–20 mg. paramethasone) or 40 units of ACTH in intravenous drip if this is the drug chosen. In older patients, consideration of the patient's physical condition may render necessary modification of dosage.

Cerebrovascular Insufficiency

The importance of ophthalmodynamometry in the recognition of occlusive disease of the cerebrovascular system has already been mentioned. Approximately 25 percent of those patients who have varying degrees of occlusive disease of the cerebrovascular system exhibit extracranial symptoms such as transient blurring of vision which lasts but a few seconds to a minute or so, diplopias, homonymous hemianopsia, or even complete blindness. The dependency of certain portions of the brain upon oxygen is well illustrated in occlusion of the central artery of the retina. When this is complete, if the patient is immediately given continuous oxygen, vision can be greatly restored as long as the oxygen is given. In the interim, therapeutic or spontaneous improvement may occur in a retina which has been kept viable.

Certain terminal areas of vascular supply exist in the brain, especially the border zones between the terminals of the anterior, middle, and posterior cerebral arteries. The posterior portion, including the visual cortex, is supplied by the terminals of these cerebral arteries, and is an important border zone for ophthalmic consideration. When transient hypoxia occur, lasting only seconds to a few minutes, normal function will return when the circulation improves. However, when there are repeated occlusive attacks and these exceed the critical period, there is progressive and permanent destruction of the nerve cells.

Carotid Insufficiency

Hoyt (1959) has pointed out that the predominant symptoms of anterior cerebral artery insufficiency are motor weakness or paresthesias of the legs and those of middle cerebral artery insufficiency are motor weakness of the face, arm or hand, paresthesias of the face, arm or hand, and aphasia, depending upon whether the right or the left middle cerebral artery is involved. Posterior cerebral artery symptoms are in the direction of transient attacks of blindness, which may or may not be hemianopic in character. Thus a patient may notice that he loses half of the right or left fields of both eyes or he may actually black out almost entirely. Older patients frequently complain of transient blackouts of vision, and while the majority of these never go blind on the basis of even marked occlusive vascular disease, a sufficient number do exhibit enough visual impairment that this complaint should always merit attention.

These symptoms are often transitory at first and, therefore, premonitory in nature. One should always heed the warnings. Often it will be found that many of these patients have a previous cardiac history of having been on anticoagulant therapy for non-ophthalmic complaints. When the occlusive process has progressed to thrombosis, the symptoms become more dramatic and may become permanent. The permanent symptoms are loss of consciousness, contralateral hemiplegia and hemianesthesia of the face, arm and leg, contralateral homonymous hemianopsia, and homolateral Horner's syndrome. If a good collateral circulation develops during the period while the occlusive process is progressing slowly, the symptoms may not be permanent and may be similar in nature to the premonitory ones.

Treatment

Recent advances in surgery of the arteries and the use of anticoagulants and fibrinolytic agents offer prospects of helping these patients. According to Fisher (1959), transient monocular visual loss is a hallmark of carotid insufficiency. A single episode of

transient loss of vision in one eye without any localizing neurological signs presents a difficult diagnostic problem. Wagener (1957), in discussing the differential diagnosis of amaurosis fugax, suggests that transient fleeting losses of vision indicate offending etiologies of migraine, impending closure of the central retinal artery, and temporal arteritis as the most important considerations. When attacks of monocular blindness occur in patients with carotid disease, they may last as long as 10 minutes without any ensuing conspicuous visual loss. Transient hemianopsia is rarely observed as part of the carotid insufficiency syndrome, although it can occur. The pupillary light reflex is absent during the attack of monocular blindness. That is, if light is cast upon the pupil of the blind eye, the pupil will not react, although it may react consensually to light cast upon the opposite pupil.

Intermittent Insufficiency of the Vertebral-Basilar System

According to Hoyt (1959), these symptoms are abrupt in onset lasting seconds to minutes and disappear without leaving any neurological signs. Repeated attacks may occur over a period of many months before a stroke does occur. Hoyt considers the following as the more important of transient and hence prodromal symptoms: (1) headache; (2) dysarthria; (3) dysphagia; (4) paresthesias in the face, one arm or half of the body; (5) hemiparesis; (6) vertigo, dizziness, and nausea; (7) unilateral tinnitus; (8) clouding of sensorium or loss of consciousness; (9) diplopia; (10) ptosis; (11) bilateral visual blurring or hemianopic visual loss.

While it is often difficult on clinical grounds to differentiate between vertebral insufficiency and insufficiency in the basilar artery, it is important to recognize the syndrome as a whole. These patients should not be dismissed casually as being senile or presenting symptoms which are common in their age group and, therefore, unimportant. If no definite diagnosis can be established, the patient should definitely be followed and be told to return the minute that any troublesome symptoms occur. The *treatment* is that given for any occlusive vascular disease, and that means anticoagulation and possibly vascular surgery.

Other Sclerotic Changes

With advancing age, progressive arteriosclerotic changes in the optic nerve may produce atrophy. Vessel occlusions may occur within the optic nerve or in its nutrient supply. The pressure of sclerotic carotid arteries on the intracranial portion of the optic nerve may produce a picture that ophthalmoscopically resembles glaucoma and is known as *cavernous optic atrophy*. This produces bizarre visual field changes. The extraocular nerves may also be affected in the elderly, especially in those with diabetes or high blood pressure. The resultant nerve palsies most often involve either the medial or lateral rectus muscles. Aneurysms of the Circle of Willis also cause eye muscle palsies which are responsible for causing ptosis (drooped lid) and diplopia (seeing double).

GLAUCOMA

Glaucoma, increased intraocular pressure, is one of the most important senescent changes, the incidence of which increases with advancing age. This disorder exists in many forms: acute glaucoma; chronic wide angle glaucoma; and chronic narrow angle glaucoma. It may be secondary to other ocular diseases, such as uveitis and tumors. The chance that a patient will have glaucoma increases markedly with age, for about 90 percent of all cases occur in patients more than 40 years old. The most common is the chronic wide angle variety.

Acute Glaucoma

This is always due to an acute obstruction of the anterior chamber angle, or angle between the root of the iris and cornea, through which the aqueous humor drains back into the circulation. Rarely is this obstruction relieved spontaneously. If unrelieved, vision will be lost.

Symptoms

Tension in any hollow viscus causes excruciating pain. Acute glaucoma is no exception, creating as it does the most agonizing discomfort. Vomiting is often present so that a gastrointestinal disease may be erroneously suspected. Halos or rainbows around lights, a symptom also produced by sclerosis of the lens nucleus and sometimes by tears or mucus on the eye, are often seen in acute glaucoma and are caused by corneal edema. In acute glaucoma, however, the halo or rainbow effect may not be noticed because of loss of visual acuity.

Signs

The eye is reddened by ciliary injection, the pupil is

dilated, the anterior chamber is shallow, and the cornea is steamy with irregular light reflexes.

Alternate pressure on the globe by the index fingers will reveal a hardness, even a stony hardness, of the affected eye as compared with the normal eye.

Tonometry

Obviously a more accurate determination of intra-ocular pressure can be obtained by direct measurement. Tonometry can be done by any physician, and should be a part of every complete physical examination.

It is wise to be instructed in this procedure by an ophthalmologist. This is carried out as follows: the patient lies down; both eyes are anesthetized (both should be tested); then, as the patient looks directly upward at his own index finger or some other object, the lids are separated, the foot of the Schiotz type tonometer is set lightly but firmly on the center of the cornea, and a reading is promptly taken while the shaft of the tonometer is held absolutely vertical. It is important not to permit pressure of either set of lids on the eyes.

The lower the reading on the scale, the higher the intra-ocular pressure. The tonometer is equipped with a built-in 5.5 mg. weight. With this weight, a reading of 4 is considered the upper limit of normal. A reading of 3 is probably pathologic. A reading of less than 3 must be considered pathologic unless proved otherwise. Any reading of 3 or less should be correlated with a reading obtained using a heavier weight such as the 10 mg. or 15 mg. (a card for such correlation accompanies the instrument).

Low or questionable readings indicate referral to an ophthalmologist or, if this is impossible, the patient must be closely followed. While the vision-destroying capacity of glaucoma must never be forgotten, it is almost equally important that a definite diagnosis not be made on the basis of a single pressure reading. Rather, if asymptomatic, the patient should be told that his pressure is high and that careful followup and additional confirmatory tests should be carried out.

Gonioscopy

The gonioscopic lens is a combination of a contact lens and mirror which allows the observer to look directly into the angle of the anterior chamber. He is thus able to determine whether the angle is normally open or closed.

Treatment

The treatment of acute glaucoma consists of the use of double or quadruple doses of a carbonic anhydrase inhibitor orally, such as acetazolamide (500–1000 mg.), ethoxzolamide (125–500 mg.), or dichlorphenamide (100–200 mg.). If effective, intraocular tension will be considerably reduced within one and one-half hours. Oral glycerol (1–1.5 mg./KG) mixed in water, makes for good initial therapy, or can be used if the carbonic anhydrase inhibitor fails.

Simultaneously, the patient is given miotics, such as 2 to 4 percent pilocarpine applied topically every 15 minutes until the pupil is constricted. If the intraocular tension is not reduced by the above, the patient should be given acetazolamide intravenously. Often this will reduce the tension when the oral medication has failed, and will produce an effect within 15 to 30 minutes. If these measures fail, the patient should be given 30 percent urea intravenously in a dosage of 1 Gm./kg. of body weight. This is a hospital procedure and is rarely needed. This will reduce intraocular pressure in practically every patient, not only in the hard eye but also in the normal one.

If these measures have produced no relief, an iridectomy, preferably a peripheral iridectomy, should be carried out without delay. This will usually control the patient's symptoms and, in addition, prevent further attacks.

If the acute attack responds to the medical therapy outlined, the patient should be advised to have a peripheral iridectomy to prevent further attacks. Preferably, this surgery should not be carried out until the eye has become pale and quiescent.

In these patients, the tension is often elevated in the opposite eye as well. In any event, that eye must be regarded as potentially glaucomatous. Where a moderate elevation is found, or where patients reside long distances from medical aid, a prophylactic peripheral iridectomy of the other eye may be desirable.

Chronic Glaucoma

The chronic forms of glaucoma are divided into those with an open or wide anterior chamber angle and those in which the angle is closed or narrow.

Open (Wide) Angle Glaucoma

This condition is due to some failure in the facility for outflow of aqueous humor, possibly to a defect in the trabeculum of the anterior chamber. It is a chronic, slowly progressive disease, rarely associated

with acute attacks or with definitive symptoms. The patient may complain of vague headaches, he may be continually wiping his glasses, his glasses may require frequent changing, or he may tear constantly and on one side if unilateral.

Since there are no distinguishing symptoms and the intraocular pressure may not be greatly elevated, diagnosis may not be made unless the patient is examined with a tonometer, with repeated testing in suspicious cases. Indeed it is again suggested that tonometry should be a part of every routine physical examination in order to pick up these patients before damage to vision results.

Course

Eventually, if untreated and possibly even if treated, excavation of optic nerve will occur (with loss of visual field and vision).

Treatment

This type of chronic glaucoma responds very well to miotics, starting with 0.5 percent pilocarpine or 0.75 percent carbachol, and increasing the dosage to 1 or 2 or more percent pilocarpine or 1½ percent carbachol. Both drugs, when they fail to control the condition adequately, can be supplemented by a levo-epinephrine. (This latter drug should not be used in closed angle glaucoma.) Eserine ointment can be applied at night, and/or carbonic anhydrase inhibitors can also be used. With early diagnosis and adequate medical care, few of these patients should come to surgery.

Close (Narrow) Angle Glaucoma

This type of chronic glaucoma is characterized by intermittent attacks during which the angle closes. In many patients the initial attacks will be of brief duration and clear up spontaneously. However, each attack tends to produce adhesions in the anterior chamber angle which eventually will become either partially or completely obliterated. Surgery then becomes an absolute necessity.

In this type of chronic glaucoma, surgery is the treatment of choice. When done early, a peripheral iridectomy will usually be adequate to prevent further attacks. This operation is much neater cosmetically and just as effective as the old full iridectomy. One advantage of peripheral iridectomy is that it does not prevent more extensive surgery later, if that should prove necessary.

It is probable that, because of the increased medical awareness of the problem which has led to earlier diagnoses than formerly, there will be a marked decrease in the incidence of visual disability due to glaucoma in the years to come. The earlier in its course that chronic glaucoma is discovered, the less is the ocular damage and the easier it is to preserve the patient's vision and visual fields. Stress on routine tonometry has uncovered a high percentage of both early as well as potential glaucoma, and before any appreciable ocular damage has occurred.

MISCELLANEOUS CONDITIONS

Vitreous Opacities

One of the most prominent ocular complaints, starting at about the age of 40 or 50, is that of spots before the eyes. These are usually due to benign degenerative changes in the vitreous; they are annoying, but are otherwise insignificant. The spots may also be caused by small vitreous hemorrhages. This condition warrants careful investigation because it can be associated with retinal detachment. Larger vitreous hemorrhages, which are more common in diabetic and occasionally hypertensive patients, obscure vision but fortunately have a high incidence of spontaneous resolution. These, too, warrant thorough investigation, for a large vitreous hemorrhage often masks retinal detachment. The vitreous floaters "swim" all over and hence the "shadow" does not occupy a constant relationship to the eye, moving around as it does. The shadow cast by a retinal hemorrhage or lesion is constant in relation to the eye's position.

Lids and Skin

With increasing age the lid skin becomes thinner, wrinkled (the familiar "crow's feet" at the corners of the eye), and more pigmented, exhibiting various keratoses (Burn, 1958). Senile stretching is seen in varying degrees, with excess skin on the upper lids hanging down in folds. In many individuals, "bags" appear under the lower lids. These are often seen on a familial basis, and are usually due to dehiscences in the periorbital septum, permitting herniation of orbital fat.

Ptosis tends to be more common in the older age group. Entropions (inversions) and ectropions (eversions) are a source of annoyance causing tearing, and in the case of entropion, actual irritation of the cornea. When the lids become lax and do not hug the globe, the lacrimal puncta fail to exercise their normal drainage function, and increased tearing ensues.

Conjunctiva

The conjunctiva becomes thinner and more friable. Subconjunctival hemorrhages occur more often in this age group. There is greater susceptibility to cold and wind and dust with consequent increase in tearing. Sandy sensations and other complaints referable to "conjunctivitis" are common. Pinqueculae are seen as small yellowish papular enlargements, usually nasal to the limbus.

Conjunctivitis which is aggravated by polluted air is an important condition in the aged, because threshold for pain is markedly lowered in older people. The use of a mild ocular decongestant, such as tetrahydrozoline, 0.05%, or a topical steroid often brings great relief. When a truly infected conjunctivitis occurs, it should be treated with a suitable topical antibiotic.

Cornea

The cornea becomes less translucent and acquires a smoky appearance. A white or yellowish ring is frequently seen in the corneal periphery, near the limbus (arcus senilis). Dystrophic changes are common, especially in the endothelium. When the latter become widespread with superimposed epithelial dystrophy (Fuch's Dystrophy), vision becomes markedly impaired.

Sclera

The sclera is rarely indicated as the site of significant senile changes. Occasionally a grayish, atrophic area is seen over the insertions of the horizontal rectus muscles, the so-called hyaline scleral plaques. These have no pathological significance. Rarely the sclera exhibits a necrotizing scleromalacia perforans, which may destroy the globe.

CONCLUSION AND SUMMARY

An attempt has been made to outline some of the more important ocular physiologic and pathologic changes found in the 65 and older population. The author found that approximately 1 out of every 6 patients (15.5 percent) studied fell into this group. Surprisingly, over 80 percent of this group had vision of 20/50 or better. The chief causes of visual incapacity were cataracts, macular disease, glaucoma and vascular changes and accidents. Many other diseases which are found in younger individuals are also seen in the older age group, often in more advanced stages.

With a continued marked increase in the number of senior citizens, many of whom are otherwise well excepting for poor sight, the problem of preservation and restoration of their vision has become a major ophthalmological problem. A brief analysis of this matter and some suggested approaches to therapy have been offered with the hope of stimulating more attention to this area of ophthalmology.

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OTOLARYNGOLOGICAL PROBLEMS IN THE GERIATRIC PATIENT

By

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INTRODUCTION

The following discussion on diagnosis and treatment of ear, nose, and throat disorders and communication problems of elderly persons is directed to the non-specialist practitioner who provides care to geriatric patients; it is not intended for the specialist in otolaryngology, audiology, or speech pathology.

Of greatest importance is the need for the physician to be aware of the fact that many of the ear, nose and throat problems which appear to be identical in young and old patients should not necessarily be treated in an identical manner. The mental, emotional, and physical needs of a 70-year-old who suffers a sudden hearing loss may be quite different from those of a young person affected by the same disorder; accordingly, the prescribed course of treatment for an elderly patient should be developed with an understanding of the special needs of this age group.

HEARING DISORDERS

Hearing and equilibrium must receive major emphasis when speaking of ear, nose and throat problems in any age group, and this is especially true in the case of the older patient. Although some people retain usable hearing throughout their lives, most develop some hearing deficiency which interferes with good communication. As developments in medical science continue to extend life, the number as well as the percentage of individuals with such deficiencies will increase rapidly.

When discussing hearing disorders, distinctions should be made among the types of hearing losses that are encountered clinically. Knowledge of the normal processes of hearing, particularly that for speech, helps in making these distinctions. When spoken words are heard normally, at least three events have occurred: (1) the sound has been conducted through the external and middle ear without losing its physical qualities; (2) it has been converted from physical sound waves to electrical signals by the sensory elements of the inner ear; and (3) the electrical signals, in the form of nerve impulses, have been transmitted to the brain by the auditory nerve.

A dysfunction in the first event produces a *conductive* hearing loss. The loss of hearing is due to an attenuation or reduction of the sound, such as occurs when one covers the ears or plugs the ear canals. If the speech is made louder, it will overcome this attenuation and can be heard with essentially normal quality. A breakdown in the second or third events on the other hand, not only reduces the loudness of speech, but may introduce distortions which render the speech partly or totally unintelligible, even when it is made intense enough to compensate for the reduction in loudness.

Hearing impairments caused by dysfunctions of the inner ear and/or nerve are called *sensorineural* hearing losses. In the past these were usually called "nerve" or "perceptive" losses. Some hearing disorders involve both conductive and sensorineural components, and are usually referred to as *mixed* hearing losses.

External Ear

Despite widespread acceptance of the idea that earwax in the ear canal causes hearing losses, it is only when there is total occlusion of the ear canal that perceptible loss occurs. Impacted cerumen in the geriatric patient usually contains a high content of keratin. This cannot be removed easily by ordinary irrigation techniques. The ear covering must be separated carefully from the canal wall with a curette without traumatizing the skin of the canal or the tympanic membrane, and then washed out with hypertonic saline solution.

Partial occlusion of the canal with cerumen occurs frequently in the elderly, and often interferes with the satisfactory use of hearing aids. This can be removed easily by irrigation with saline. Mild dermatoses, furunculosis and an occasional infected sebaceous cyst may involve the external ear canal of the older patient and should be treated early with a soothing topical medication such as a corticosteroid in a cream vehicle.

Although infrequently encountered, malignant changes may develop in the external auditory canal of patients who have had a chronic draining ear for many years. Persistent bloody drainage or an increase in granulation tissue of the middle ear region should

arouse suspicion of neoplastic changes. It is preferable to avoid the overuse of ear drops in such conditions and to obtain a biopsy early in order to establish the correct diagnosis.

Middle Ear

Atrophic or sclerotic changes of the tympanic membrane are common in the aged, but do not usually cause appreciable losses of hearing. When marked retraction of the tympanic membrane and malfunction of the ossicular chain are present, there is an accompanying moderate to severe hearing loss of a conductive type. Occasionally one finds a serous middle ear effusion secondary to a respiratory infection. This usually responds nicely to Eustachian tube inflation. On rare occasion, myringotomy, aspiration of fluid and repeated inflation of the Eustachian tube and middle ear will evacuate the fluid and produce an improvement of hearing. When improvement in hearing does occur, it is usually in the lower frequencies which allows better interpersonal communication.

There has been much discussion in the past about the hearing benefits of Eustachian tube inflation in older patients. The possibility of a malfunction of the Eustachian tube contributing to geriatric deafness should not be overlooked, but it is usually a negligible factor in the older patient's hearing deficiency.

Otosclerosis, in its most common form, producing an osseous growth which fixes the footplate of the stapes in the oval window of the cochlea, is usually thought of as a disease of youth. It is, however, an unremitting disease in that the conductive hearing loss persists throughout life and frequently progresses to involve the cochlea, ultimately producing a sensorineural audiological picture. As a result, those geriatric patients who have had otosclerosis in youth still suffer from a conductive component to their hearing loss onto which is superimposed the sensorineural loss associated with cochlear otosclerosis.

There are three possible approaches to the *treatment of otosclerosis* available to the geriatric patient. One may choose surgical correction of the fixed stapes, a hearing aid, or a combination of the two. The latter can be desirable for most patients with a severe hearing loss because surgical correction, while alone not restoring hearing in everyone to a practical level, may result in improvement to the point where a hearing aid can be used to greater advantage.

Arguments have been made against stapes surgery for the elderly patient. The most important of these is that the sensorineural elements of hearing have become impaired, and the patient's ability to understand speech would be too poor to warrant the operation. This is to say that even though sensitivity to sound may be improved, understanding of speech will remain as poor. This argument is only partly valid. Studies have shown that a majority of older persons with hearing losses have usable speech discrimination, and that many of them have excellent ability to understand spoken words. So-called "phonemic regression" is not as common as the literature might lead one to believe. An audiologic evaluation of the geriatric patient will give the necessary information concerning the "air-bone gap" and discrimination ability. As with younger patients, each candidate for surgery must be evaluated on an individual basis.

A second argument against operative intervention in the geriatric patient is that sensorineural losses may occur in the cochlea of older persons secondary to the surgical procedure. Evidence against this argument is presented by Klotz (1962) who reports the results of stapedectomies in elderly patients after 2½ years, finding that they do just as well as younger patients, provided the same selection criteria are used for both groups. He concludes that if the older patient can understand speech that is presented to him at an intensity level loud enough to overcome the otosclerotic barrier, there is no reason to deny him rehabilitative ear surgery. Farrior (1963) describes his findings following stapedectomy on 125 patients ranging in age from 60 to 87 years. He states that even in those cases where the sensorineural component and poor speech discrimination prevented a restoration to normal hearing, the patients were grateful for the restoration of auditory contact with their environment.

In the event that the conductive hearing loss is not amenable to medical or surgical correction, or the surgical procedure is unsuccessful, the patient may find that a hearing aid can be very helpful. However, the patient must be counseled regarding the fact that a hearing aid is simply an amplifying system, like a miniature and personal public address system, which makes sound intense enough to overcome the attenuation caused by the malfunctioning of the middle ear.

Inner Ear and Retrocochlear Disorders

The sensory and neural elements of hearing are closely tied together, and it is often difficult to determine just how much each is contributing to a hearing impairment. As a result, the term "sensorineural" is

commonly used to describe losses due to inner ear or auditory nerve disorders, or combinations of both. With this type of impairment, medical and surgical treatment are generally not effective.

The most important disorder due to inner ear and retrocochlear changes is presbycusis, i.e., the loss of hearing due to the process of aging. As such, it probably represents the most "truly geriatric" otolaryngologic problem.

Presbycusis is a progressive disorder which begins relatively early in life, but may reach a plateau and remain relatively stable for long periods of time. The hearing for high-pitched sounds (above speech frequencies) is affected first and most severely. As the condition progresses, the middle frequencies, containing most of the speech sounds, and eventually even the lower frequencies are involved. The audiologic picture often consists of no measurable hearing in the upper frequencies, moderate losses in the middle range, and relatively good reception in the lowest tones.

As a result of the imbalance in hearing for high and low frequencies, speech (which contains high, middle and low frequencies) may be heard in a distorted or even unintelligible manner. The patient suffering from presbycusis will usually know when he is being spoken to, but he may not always understand what is said. The words are distorted by his imperfect auditory system and comprehension requires a conscious effort. When the distortion problem is compounded by a difficult listening situation, such as several people talking at once, the patient with presbycusis will have an especially difficult time. Also, due to his imperfect auditory system, more reliance has to be placed on visual clues. Thus the presbycusic will have more difficulty in situations where he cannot observe the speaker's face.

Presbycusis is related to a number of other conditions which occur concurrently with or which cause hearing loss in the aging. The adverse effects of long exposure to noise have been demonstrated. Prolonged tension or emotional upset, cigarette smoking, cardiovascular disturbances, genetic tendency, diet, etc., may also contribute to the total problem (Weston, 1964; Rosen et al., 1962).

It is generally agreed that there are at least 2 types of pathologic change involved in presbycusis. The first, which Schuknecht (1955) calls epithelial atrophy begins in middle life and is characterized by a progressive degeneration of the sensory hair cells, supporting cells and the stria vascularis of the cochlea from the basilar turn to apex. The second type, neural atrophy, begins later in life and is associated with degeneration of the cells of the spiral ganglion and the neurons of the cochlear nerve and higher auditory pathways.

A corollary to spiral ganglionic atrophy due to aging probably exists in the brain in the form of nerve cell degeneration. Kirikae et al. (1964) found that various degrees of degeneration were seen in cells of the superior olivary nucleus and the inferior colliculus. They also reported uniform atrophy and degeneration of the ganglionic cells in the ventral cochlear nucleus and medial geniculate body. The loss of speech discrimination and auditory sensitivity are considered an expression of neuron loss in the auditory pathway.

Weston (1964) reports that a certain amount of hearing loss is virtually universal among elderly people, but it is by no means always accompanied by a complaint of deafness, even when such a disorder would appear to be quite disabling. This is in agreement with the results of a study of persons in a St. Louis home for the aged in which it was found that only about 15 percent of everyone tested complained of hearing difficulty (Senturia and Price, 1963). Although the home residents freely described poor vision, problems of hearing were denied by 85 percent. When tested, these "non-complainers" showed hearing losses which were beyond the level usually thought of as normal hearing. The ranges of hearing ability of the "complainers" and "non-complainers" overlapped considerably. Certain factors other than hearing sensitivity per se are involved. Mental, social and psychological factors must be important.

Treatment of presbycusis with vasodilators, vitamins, diuretics, hormones, etc. has been attempted with little evidence of success. Other physical and mental disorders appear to be related to presbycusis, however, and treatment of these conditions is important. In general there appears to be a positive correlation between physical and mental health and hearing.

Since the possibility of improving presbycusis by medical therapy is limited, other approaches are often needed to assist the geriatric patient. The primary source of help is auditory rehabilitation, which includes the use of hearing aids, auditory training and training in lipreading.

The patient suffering from presbycusis often can be helped by the use of a hearing aid. Contrary to commonly held opinions, *the fact that a hearing loss is sensorineural* (nerve or perceptive loss) *does not preclude the use of amplification.* Other factors are involved and the decision concerning the use of an aid

should be made on the basis of an audiological-otological evaluation. The audiological evaluation includes measurements of the patient's understanding of amplified speech and how he tolerates amplified sound. In most instances, if a hearing aid is recommended, information will be provided concerning type, style and acoustic characteristics of the best aid suited for the particular patient.

The audiologist or otologist may recommend that the patient obtain auditory training, lipreading instruction, or both. These recommendations may be made whether or not a hearing aid is recommended. Auditory training involves helping the patient to learn to use whatever residual hearing he may have. The training is usually done with amplification, and this may serve the purpose of orienting the patient to the use of a hearing aid if one has been recommended.

Lipreading, or, more properly, visual speech reception, is the skill which enables a person to understand speech regardless of the state of his auditory system. Not only is the individual taught to recognize sounds that are visible on the lips, but to use clues such as facial expressions, gestures and emotional reactions. Context of sounds, words, phrases, rate of word flow and word stress are emphasized. A patient who learns to use his residual hearing and who is proficient in speech reading will have minimal difficulty with communication in a face-to-face situation.

An additional problem faced by the geriatric patient is decreasing eyesight. Since this limits his ability to speech read, everything possible should be done to obtain maximum correction of his vision.

A very important part of the treatment of the presbycusic involves the counseling of members of his family. If they understand his hearing limitations, they will be in a better position to make family listening situations optimal for him. If each family member speaks slowly, keeps his face to the patient and obtains his attention before starting to talk, they will find communication with the hearing-impaired member much more pleasant and profitable.

Sudden Hearing Loss. Vascular changes involving branches of the internal auditory artery can result in sudden hearing losses. This type of loss is considered to be the result of constriction or occlusion of blood vessels, or hemorrhage within the organ of Corti. This condition should be considered a therapeutic emergency and treatment started as soon after the accident as possible. A delay of several days before treatment may result in reduced opportunity for recovery.

Viral infection of the organ of Corti may also produce a partial or completely irreversible loss of hearing. It is postulated that losses due to viruses can be differentiated from those due to vascular accidents in that a virus induced loss develops over a period of hours or days, while a vascular accident causes instantaneous loss.

Vestibular Disorders. Many patients with dizziness have benign paroxysmal postural vertigo. This is characterized by sudden and short spinning sensations and marked nystagmus after rapid changes in the position of the head. In the geriatric patient, vertigo is often associated with vascular changes.

Some patients with vertigo exhibit osteoarthritic changes in the cervical vertebrae. The mechanism of this condition is thought to be due to constriction of one or both of the vertebral arteries in the encroached foramen producing a transient ischemia of the inner ear (Torok, 1964). Any other disorders which cause transient interruption or decrease in the blood supply to the inner ear may also produce these vertiginous episodes. Many persons who describe dizziness or spatial disorientation have no demonstrable organic disease. In the absence of systemic disease, the practitioner should obtain otological and/or neurological consultation.

Associated Conditions

Cerebello-Pontine Angle Lesions. A gradual, progressive, unilateral sensorineural hearing loss, with poor speech discrimination and intermittent attacks of vertigo early in the history, should be studied for a possible eighth nerve or cerebello-pontine angle lesion. Tumors of this nature are rare, but should be considered a possibility when the above signs and symptoms are present.

Tinnitus. Head noises are caused by many pathologic processes. Otologic disorders such as impacted wax in the external canal, middle ear effusions, labyrinthine disease, blocked or partially patent Eustachian tubes, exposure to loud noises, etc. may be accompanied by tinnitus. In addition, systemic diseases which indirectly affect the auditory system, such as diabetes, nephritis, nutritional deficiencies and allergies may cause tinnitus. Excessive use of or sensitivity to certain drugs, such as quinine and salicylates, may cause tinnitus.

Temporo-Mandibular Joint Syndrome. Pain or discomfort in the area of the ear, sometimes accompanied by mild conductive hearing loss, may result from im-

properly fitted dentures. An osteoarthritic condition of the joint may occur, causing pain and discomfort in the ear radiating down the ramus of the mandible. Treatment consists of splinting the mandible, application of heat, and analgesics. Properly fitted dentures will usually alleviate the problem.

LARYNGEAL DISEASE

Any older person remaining hoarse despite proper care of the nose and throat and restricted use of the voice over a period of 2 weeks should be seen by a laryngologist. Cancer of the larynx occurs mainly in the older male patient and tends to be neglected in the early stages because of the usual well-being of the patient and the absence of pain. Radiation therapy provides complete cure in a high percentage of early lesions. On the other hand, surgery offers good results for the moderately advanced lesions but there is a poor prognosis for the advanced lesions with any treatment.

Speech and Language Disorders

In this section, 4 problems affecting the speech and language of the geriatric patient will be considered. These problems are not unique to the older patient, but do occur often enough in this age group to make them of special interest to those who work with a geriatric population. The 4 areas are: (1) deterioration of speech due to hearing loss; (2) language disorders due to a breakdown in the symbolization processes of the brain; (3) speech problems resulting from neuromuscular disorders; and (4) the loss of speech following a laryngectomy.

Deterioration of Speech Due to Hearing Loss. Some deterioration of speech often occurs in association with loss of hearing sensitivity, whether due to aging or otherwise. This is the result of a breakdown in the normal feedback system in which the ears serve as a monitor of the speech of the individual.

In presbycusis, where the higher frequencies are affected first and most severely, the hearing of higher pitched speech sounds such as *s*, *f*, *sh*, and *th* deteriorate first. If the loss progresses to the point where the lower and middle frequencies are also involved, factors other than loss of precision may become apparent. Speech can become monotonous, intonations may be lost, and there can be a loss of loudness control.

Amplification of sound (use of hearing aid), auditory training, training in visual speech reception, and medical and surgical correction of hearing losses are possibilities to be considered for the patient with hard of hearing speech. These approaches have been discussed earlier.

Language Disorder Due to a Breakdown in the Symbolization Process of the Brain. Aphasia is a failure in the production and/or understanding of speech. This failure, assumed to be due to a breakdown in the ability to attach meaning to the symbols normally used in spoken and written language, results from damage to portions of the brain that seem to be most responsible for speech functions. It may involve the reception, integration and/or expression of symbolic forms, each or all to a greater or lesser degree. It is not related to, but may be concurrent with neuromuscular disorders which cause speech difficulties.

In the older patient the most common cause of aphasia is a cerebrovascular accident. Other causes are physical trauma, neoplasms and infectious diseases. Also, nerve cell losses in the brain seen in senility sometimes produce aphasia-like symptoms.

Most patients suffering from aphasia show evidence of both receptive and expressive disorders. One or the other often predominates, but it is frequently difficult to determine whether reception or expression is the more severely impaired.

Receptive Aphasia. The receptive element in aphasia refers to the patient's inability to understand spoken words. This auditory imperception can vary in degree, ranging from the loss of comprehension of isolated words to the loss of whole ideas. A patient with a severe receptive disability has a relatively poorer prognosis since even the speech therapist may not be able to communicate with him. However, spontaneous recovery sometimes occurs in the receptive aphasic, and in other instances, the relearning of speech may be quite rapid.

Expressive Aphasia. In the patient whose problem is primarily expressive, as in the one whose problem is primarily receptive, the extent of disability varies. Such a patient may have difficulty in finding the appropriate word at the right time. If so, he may use circumlocution or substitutions in place of the lost word. He will recognize and comprehend the word if it is spoken to him. Another characteristic of expressive problems is the tendency to omit, substitute, and transpose sounds in words. Word order and word endings may be jumbled. Often the function words are omitted and the speech will consist mainly of nouns and verbs with perhaps a few adjectives. The prognosis for

the expressive aphasic is usually better than for the receptive.

Therapy for the aphasic should be started as soon after the brain injury as possible. Even if the patient is moving toward spontaneous recovery of language function, speech therapy is indicated. The patient who would eventually recover to normal or near normal language ability benefits from the support, reassurance and guidance of therapy. Also, some patients experience some spontaneous recovery, but continue to have residual difficulties. These patients benefit from early therapy in that a training pattern is established, some success is experienced, and motivation to improve is enhanced.

A very important part of the speech rehabilitation of the aphasic patient, as with patients experiencing other communication disorders, is counseling of the family. Aphasia is often an especially difficult concept for the family to grasp, and an understanding of the patient's language ability, or lack of it, is paramount. Further, an understanding and cooperative family, when properly instructed, can assist in the therapeutic process of restoring language function to the patient (Penfield and Roberts, 1959).

Speech Problems Resulting From Neuromuscular Disorders. The term "dysarthria" refers to disorders of speech resulting from motor disturbances in the speech producing mechanisms. These motor disturbances are the result of lesions in the central and peripheral nervous system and occasionally in the muscles themselves. The articulators of speech are primarily involved, although respiration, phonation and resonation may be affected. In dysarthria, symbolic function is intact and the speech disorder is due entirely to difficulty in performing the coordinated neuromuscular activities necessary for the production of speech.

This incoordination may result from upper motor neuron lesions, cerebellar disorders, lower motor neuron lesions and/or myopathies (Brain, 1962). Upper motor lesions result in weak, spastic articulation muscles, and speech is slurred. Consonant production may be severely affected. Lesions of the corpus striatum, such as in Parkinson's disease, result in impaired articulation due to immobility of the lips and tongue, and the voice has a monotonous pitch. Cerebellar lesions result in uncoordinated speech efforts. Speech may be explosive, syllables unduly separated, and grimaces present when efforts are made to speak. Lesions of the lower motor neurons cause weakness of the articulatory muscles and may even result in impaired phonation. Finally, diseases of the muscles, such as myasthenia gravis, may lead to a dysarthric condition similar to that resulting from lesions of the lower motor neurons. Causes of dysarthria, in addition to those named above, are progressive bulbar palsy, pseudobulbar palsy, multiple sclerosis, muscular dystrophy of the facial muscles, Bell's palsy and Friedreich's ataxia.

Prognosis for retention of speech in the patient with dysarthria is dependent upon several factors. The prognosis will be poorer, of course, in persons with chronic and progressive diseases. In other patients, where there are periods of fair stability, the teaching of rate control, phrasing and more precise articulation may be helpful. Even in cases with poor prognosis for speech rehabilitation, speech therapy may be of value in motivating the patient to use whatever ability he may still have.

Loss of Speech Following Laryngectomy. Patients who have had a laryngectomy because of cancer are seen more frequently now than in the past as a result of better diagnostic methods and improved surgical and medical techniques. In the not-too-distant past, there was little hope of survival for the patient with a diagnosis of laryngeal carcinoma. Now a very high percentage of patients with laryngeal cancer can expect to survive, provided the disease is diagnosed at a fairly early stage. The result is that the speech pathologist is now seeing more and more patients who have lost their ability to talk and must be taught a new method of communication.

During a total laryngectomy, an opening is made in the neck and the trachea is anchored at this point so that all air inhaled or exhaled passes through the tracheostoma. Such a patient does not produce sound (phonate) in the usual manner, nor move air through his mouth and nose.

Following surgery, the laryngectomee has three alternatives: (1) he can remain speechless and communicate by pencil and paper; (2) he can learn esophageal speech; or (3) he can learn to use an artificial larynx. Obviously the first alternative is most unsatisfactory.

Esophageal speech is the nearest substitute for normal speech. As in normal speech production, phonation is produced by the passage of air between approximated folds of tissue. The difference is that the esophagus and the cricopharyngeal sphincter are usually substituted for the lungs and vocal cords. The patient using esophageal speech swallows air and forces it back up in the form of a prolonged burp. He then uses

the usual articulators (teeth, tongue, lips, etc.) and resonators (oral and nasal cavities and other resonating spaces and structures) to convert the sound-stream into audible words. The tone produced in esophageal speech is low in pitch, but may not be abnormally so. Skilled esophageal speakers swallow air quickly and maintain phonation long enough to produce up to twenty syllables. Their speech may be essentially normal to the listener.

Not all persons are able to obtain the degree of proficiency in esophageal speech described above. The range of ability is great. Some 70 percent of laryngectomized patients can be taught to have good fluent esophageal speech, 16 percent can achieve fair ability, and 14 percent fail to learn the technique (Gardner, 1951). Success, in most instances, is related to willingness to learn.

Those who cannot or choose not to learn esophageal speech, but do not choose to remain mute, may turn to an artificial larynx. These appliances are constructed in two general types. The first is a U-shaped tube, one end of which fits into the tracheostoma and the other end into the mouth. There is an escape opening which permits air to pass in and out of the tracheostoma during breathing. If this opening is covered with a finger, the air is forced past a reed and into the mouth. The reed vibrates producing a sound in the mouth which the patient then forms into words using his normal speech mechanisms.

The other type of artificial larynx is a battery powered electric vibrator. The patient may hold the vibrator beneath his chin or against his cheek, or he may have a plastic tube which introduces the vibrations into the mouth. These vibrations produce a sound which can be articulated into speech. Disadvantages of the artificial larynx are: (1) it requires the use of the hands; and (2) it calls attention to the user.

Regardless of whether esophageal speech or the artificial larynx is decided upon, speech therapy is indicated. Much hard work and training go into the production of fluent esophageal speech; therefore, the understanding and encouragement of a good teacher are indispensable. When using the artificial larynx, many changes have to be made in the old speech patterns and proper guidance is desirable.

RHINOLOGIC PROBLEMS

The rhinologic disorders of the aging patient are not considerably different from those of the younger patient. Post-nasal drip resulting in frequent clearing of the throat is very common, but usually there is little evidence of pathologic change in the nose or nasopharynx. There may be a loss of the sense of smell as one grows older, but this condition has received little attention from investigators and no treatment is available.

Frequently there is a complaint of dryness of the nasal vestibules. Lanolin or lanolin vaseline mixtures applied to the nares give excellent results. In eczematous conditions, a mild corticosteroid in a cream or vaseline base is beneficial.

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SECTION A/DISEASES AND DISORDERS MOST RELEVANT TO SINGLE ORGAN SYSTEMS

Part III/The Nervous System

NEUROLOGICAL DISORDERS OF THE ELDERLY

By

Simeon Locke, M.D.

INTRODUCTION

The organization of the central nervous system is largely concerned with stimulus response relationships. It is a dynamic system with a remarkable capacity for adaptation. Physiological—and probably anatomical—alterations with growth and development reflect its plasticity. Because the nervous system matures late, this continuing dynamic process persists well into adult life. Like many other organs, it has an enormous reserve. It is undoubtedly this reserve which allows selection of response, variation of behavior, and even loss of substance without striking alteration of function.

Neurological disorders of late life may be associated with loss of brain substance, decrease of gyri, widening of sulci, fallout of nerve cells, reduction of white matter, and loss of brain weight, with or without associated vascular changes, glial nodules, and Alzheimer's tangles. Such disorders are probably an accompaniment of the aging process.

The dissociation between chronological years and morphological change cannot be overemphasized, however. Nor can the comparative independence of physiological aberration and anatomical change. Small, shrunken brains with reduced anatomical substance may be capable of normal physiological performance. Contrariwise, dementia or impairment of other functional capabilities need not have associated evident morphological abnormality. Nerve cell loss is frequently gradual and diffuse. Focal signs are lacking. Insidious changes in total behavior are often initially unrecognized. New behavior patterns are a composite resulting from absence of function ascribable to the neurological deficit, new and previously inapparent responses released by the deficit, and compensatory techniques evolved by use of residual nervous function.

NEUROLOGICAL CONCOMITANTS OF AGING

Psychological Changes

Alterations of mental status that reflect an underlying disorder of cerebral substance always have characteristics of an *organic dementia.* Dementia—a descriptive term and not a pejorative—may go unrecognized unless specifically sought, for it may masquerade as a functional psychosis, emotional liability, or merely an accentuation of previously noted personality characteristics.

The hallmarks of an organic dementia include loss of adaptability, increasing rigidity of response, decreased learning capacity, and memory deficit. Of these, the last is the easiest to verify objectively. It is recent memory that is impaired while remote memory is often strikingly preserved. Ability to learn is decreased, flexibility of response is diminished, and adaptability to new environmental situations is reduced.

Fixed response patterns emerge as useful if somewhat stereotyped behavior. Rigidity of reaction results in the need for stability of environmental conditions. New places and new situations may precipitate confusion.

Failing memory can be shored up by compulsive behavior. Repetitive response patterns reduce the number of demands upon the failing memory.

Misinterpretation of environmental stimuli may appear as a psychological aberration. The normal ability

to discard the multiplicity of insignificant stimuli which impinge from the environment is lost in dementia. Fragments of conversation, or other environmental noises that do not ordinarily reach consciousness, may be misinterpreted as voices. The examiner, failing to recognize the actual source, diagnoses a paranoid reaction. Failing eyesight, decreased hearing, and reduced exploratory tactile behavior reduce the availability of stimuli that normally evoke appropriate behavior.

Injudicious use of sedative medication adds to nocturnal confusional states. Often these are best handled with the use of a night light, mild sedation such as diphenhydramine, or even the use of small quantities of alcohol.

Motor Disorders

Motor disorders of late life may result from generalized cell loss, but more often they are associated with underlying lacunar state. In the presence of small vessel disease, such as that associated with diabetes mellitus or hypertension, retraction of nervous tissue from about the walls of the small blood vessels occurs along with microinfarctions.

Arteriosclerotic Parkinsonism results from vascular disease of the basal ganglia. A posture of flexion is produced with poverty of movement as an accompaniment. Rigidity with increased resistance to passive manipulation, a vacuous expression, and occasionally tremor complete the picture.

Paralysis agitans or idiopathic Parkinsonism should be separated from the arteriosclerotic form which results from vascular lesions in the basal ganglia and from the postencephalitic and toxic form of the syndrome. Although not a motor disorder strictly of late life, it is not infrequently seen. In reflecting the pathological change in substantia nigra, globus pallidus and the cortical fibers that project to them, paralysis agitans is characterized by a posture of flexion with associated bradykinesia, a pill-rolling tremor and cogwheel rigidity. The disorder responds moderately well to Artane and Benadryl. More recently there has been great enthusiasm for the use of generous doses of L-DOPA in the treatment of this disorder. Despite the emotional symptoms that are often an accompaniment of this syndrome, phenothiazines and related drugs should not be used because of their potentiating effect on the Parkinsonian manifestations.

Gegenhalten or paratonic rigidity, also a disorder of the elderly, consists of generalized resistance to passive movement characterized as a counter pull present throughout the entire range of movement. It is proportional to the stimulus, often associated with apraxia and dementia as well as prehensile reflexes such as grasping, sucking and rooting. It is usually a manifestation of bilateral cortical disease.

Pseudobulbar states result from bilateral hemisphere infarctions with spasticity and pyramidal signs. A bilateral extensor plantar response is usual. Most characteristic of pseudobulbar palsy is the dislocation of emotional response described as incontinence or lability. Uncontrolled laughing or crying may occur without the associated alteration of mood that one expects. In response to a minimal stimulus, an overflow of tears may occur, to cease abruptly as they began, in a matter of moments.

Essential, familial or senile tremor, as it is variously known, is a characteristic motor disorder of late life and is often confused with Parkinsonism. Although it may occur in families, sporadic appearance is not uncommon. In contrast to Parkinsonism, the tremor affects axial as well as appendicular structures. A side-to-side or up-and-down resting tremor of the head, an arrhythmic, irregular, lateral deviation of the individual fingers intensified by action, and an occasional cerebellar proximal component manifest themselves clinically by difficulty in manipulating the soup spoon or coffee cup. The disorder is benign, frequently only slowly progressive, and rarely debilitating except in the social sense.

Senile chorea, a movement disorder of late life, consists of persistent athetosis affecting fingers, lips and tongue, intensified by activity, often only prominent in associated movements, and fundamentally no different than the movements of Huntington's Chorea. In contrast to Huntington's Chorea, however, the associated dementia may be lacking.

The apraxias warrant a special consideration in neurologic symptoms of the elderly. Apraxia is a bilateral motor disorder produced by a unilateral hemisphere lesion. It occurs only with lesions of the dominant hemisphere. However, the left hemisphere, although usually dominant for language, must not be accepted as dominant for all functions. In apraxia, the patient behaves as if the concept of the movement pattern is lost. He exhibits preservation of normal muscle function, but cannot execute the appropriate movements with the intact muscles except under very special, concrete circumstances. Patients may be unable to per-

form "as if" acts. When requested to show how to blow a kiss or blow out a match, the performance cannot be undertaken. Lower level apraxias may affect even such fundamental processes as gait. Brun's ataxia, literally an apraxia of gait, is often seen in association with a grasp reflex, sucking response, and other prehensile tropisms in the presence of bilateral, frontal lobe disease. It is as if the patient has forgotten how to walk, for he stands immobile, rooted to the ground. Once gait is initiated, its continuation can be carried on until the patient stops, is compelled to turn, and start over. A tendency to stoop forward is associated with bilateral frontal lobe lesions, while a tendency to fall backwards is the hallmark of biparietal involvement.

COMMON ILLNESSES OF LATE LIFE

On this background of generalized change of nervous tissue that occurs with aging, coupled with associated psychological and motor impairments, there may be grafted a number of disease states which, though not unique to the geriatric population, reflect the increased liability of the elderly.

Clearly, advanced age offers no specific protection against neurological disorders. Cerebral neoplasm, metastatic tumor, nutritional deprivation states, toxic disorders, meningeal and central nervous system infections occur in the elderly as they do in the young.

Peripheral Neuropathies

Peripheral neuropathy is a generalized term for a disorder of peripheral nerves that occurs anywhere from the spinal root to the point of innervation of muscle. It is manifest by weakness, loss of reflex, and sensory loss in the distribution of the affected nerve or nerve root.

When a nerve root is affected, the disorder is described as a *radiculopathy*. Usually a radicular syndrome affects more than one nerve root. Radicular syndromes are comparatively uncommon, seen in association with collagen vascular disease, or as a postinfectious syndrome of Landry's ascending paralysis or the Guillain-Barre syndrome.

When a single mixed spinal nerve is affected, the disorder is designated as a *mononeuropathy*. The implication of an underlying vascular lesion seems justified, although frequently this is in association with a metabolic disorder such as diabetes, and recurrent trauma to the nerve. When several mixed spinal nerves are simultaneously involved, the entity is spoken of as *mononeuropathy multiplex*.

The most usual peripheral neuropathy is a *polyneuropathy*, in which the long nerves are affected before the short, so that symptoms appear in feet before hands. The affection of multiple overlapping nerve terminals produces symptoms in a "glove and stocking" distribution. The Achilles tendon reflex disappears, perception of vibration is reduced, and paresthesias may be noted. Nutritional impairment, toxic exposure, and metabolic disorders such as diabetes must be considered in the presence of these symptoms. It is true, however, that similar changes have been noted with advancing age without a demonstrable underlying disorder.

Increasing awareness of the relation between a peripheral polyneuropathy and a remote carcinoma has occurred of late. Carcinoma of the lung in particular, but also carcinoma of the gastrointestinal tract, the female reproductive system, and the female breast are noted with increasing frequency to be associated with neurological distrubances at a distance, without the intercession of a metastatic deposit. In addition to polyneuropathy, cerebellar degeneration, polymyositis, myasthenia gravis, spinal syndromes, and dementia have all been reported to accompany remote carcinoma. The mechanism of production of these entities is uncertain.

Spinal Syndromes

Lesions of the spinal cord may be intrinsic or extrinsic, and may be systematized or segmental. A segmental lesion produces its effect locally at the area of involvement, and produces signs of long tract release below the level of the lesion. Lower motor neuron weakness and root sensory loss occur in the idealized situation at the level of the involved segment; hyperreflexia, extensor plantar responses, and a spinal sensory level occur below the level of the lesion. Intrinsic disorder, which is systematized, affects a specific group of cells or fibers over a large number of segments. Motor system disease and combined system disease are representatives of affections of cells and fibers respectively.

Extrinsic Segmental Disease

Compressive disease of the spinal cord is one of the few urgent situations in neurology, perhaps particularly so in the elderly because the spinal vasculature tolerates compression so poorly.

Urgent workup should include X-rays of the spine at the area of suspected involvement, keeping in mind the differential level of the spinal cord and the overlying vertebrae, for the spinal cord ends at about the level of the first lumbar vertebra. Accordingly, there is a relative disparity between the cord level and bony level. A lesion suspected at spinal level, thoracic 10, may be associated with a vertebral lesion at thoracic 8.

In addition to X-rays, lumbar puncture, including dynamic evaluation, should be undertaken. Opening and closing spinal fluid pressures should be related to the amount of fluid removed, for in the presence of a dynamic block, a precipitous fall in pressure occurs following removal of a small amount of fluid. Cerebrospinal fluid dynamics should be evaluated by use of a blood pressure cuff wrapped around the neck, inflated to slightly above venous pressure for a period of 10 seconds, and then abruptly released. This bilateral occlusion of the jugular veins presents acute obliteration of the pathways for spinal fluid egress. In the absence of a spinal block, an abrupt rise in pressure should be reflected in the lumbar theca with an equally abrupt fall on release of compression. Finally, in the presence of suspected spinal cord compression, myelography should be undertaken in an effort to delineate the block and allow prompt surgical decompression.

Spinal cord compression may result from *disc degeneration*, *cervical spondylosis*, *metastatic tumor*, or *epidural infection*. All are equally important to diagnose, for all are equally threatening to spinal cord function. Cervical spondylosis is perhaps the most common of the disorders in late life. Intervertebral disc degeneration with protrusion, calcification, and ossification, produces compression of the anterior spinal cord. Buckling of the posterior ligamentum flavum may result in similar affection of posterior columns. Commonly found in heavy-set manual laborers, the disorder is apt to declare itself in declining years by a spastic paraparesis associated with prominent bladder complaints. Reduced mobility of the cervical spine is readily confirmed by X-ray demonstration of spondylosis, with or without associated lateral osteophytes that produce root symptoms in the arms with associated reflex loss.

Intrinsic Systematized Disease

The important systematized disorder of spinal cord of late life is *subacute combined degeneration* associated with pernicious anemia. This entity, which begins in the cervicodorsal region, produces posterolateral sclerosis manifest by paresthesias in hands and feet, striking loss of vibration and position sense, and a spastic paraparesis. Pathological involvement of corpus callosum and subcortical white matter similar to that in the spinal cord may produce a dementing syndrome.

Urgent diagnosis by definitive tests such as Schilling test or serum vitamin B_{12} evaluation is necessary, for in the early stages, the disorder is completely reversible on treatment, whereas in the late stages, the damage may be irreversible. Customarily, it is anticipated that the hemogram will provide evidence of a macrocytic anemia, but there are instances of well documented subacute combined degeneration of the spinal cord without hematologic abnormality. This is particularly apt to occur if vitamin therapy has provided folate supplements in the absence of vitamin B_{12}.

Common Cranial Disorders

Paget's disease is one of the more serious cranial disorders of late life capable of affecting both cranial nerves and the central nervous system. With the formation of new bone, compression of the cranial nerves as they pass through the neural foramina may occur. Multiple cranial nerve palsies result, among which are progressive deafness. Glossopharyngeal neuralgia and tic douloureux may be symptomatic expressions of Paget's disease. The central nervous system is involved because of the development of platybasia with basilar impression. Softening at the base of the cranium causes the odontoid peg to effectively rise in relation to the base of the skull. Signs of posterior fossa compression result.

Trigeminal neuralgia, or tic douloureux, may occur without underlying Paget's Disease. Insupportable, lancinating pain, limited to the distribution of one division of the trigeminal nerve, often occurs in clusters. Frequently, it is initiated by stimulation of a trigger zone. Eating may be impossible during the course of an attack. The pain of trigeminal neuralgia is so typical, it should not be confused with other entities. Each pain is brief, knife-like, and produces the characteristic tic in which the patient reaches for the involved area only to have the pain disappear before his movement can be completed. Recent enthusiastic reports about the use of Tegretol suggest the wisdom of a trial of medical therapy before more aggressive procedures are undertaken.

Temporal arteritis or granulomatous arteritis is

commonly associated with nodular changes and striking tenderness in the vessels affected. It is another cause of head and face pain and is one of particular concern in the elderly. Strictly, this should not be called headache as the discomfort is reported as being on the scalp rather than in the head. Marked elevation of the erythrocyte sedimentation rate occurs. Vascular occlusion, most commonly affecting the retinal circulation, is a hazard to be feared. Accuracy of diagnosis is important and can be made with absolute certainty only by biopsy of an affected segment of vessel. The importance of diagnosis relates to the usual good response to aggressive steroid therapy.

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CEREBROVASCULAR DISORDERS IN LATER LIFE

By

Simeon Locke, M.D.

INTRODUCTION

Cerebrovascular disorders rank high among the disabilities of the elderly. Often fatal, they more often deprive the patient of the pleasures of independence and the dignity of self-sufficiency. In 1958, there were nearly 2 million stroke victims in the United States with varying degrees of disability; more than 191,000 people died as the result of a cerebrovascular disorder. Responsible for 12 percent of the deaths, cerebrovascular disease is exceeded only by heart disease and cancer.

Clearly, the usual acute cerebrovascular insult does not result from an acute structural change in vasculature. The underlying affection of cerebral blood vessels is commonly present and insidiously progressive long in advance of the neurological catastrophe. The association of a dynamic event is often responsible for the precipitation of a lesion. Unfortunately, it is uncommon for complete restitution of neurological function to occur following a stroke.

The role of the responsible physician, therefore, is best that of delineating the fundamental underlying structural disorder of blood vessels, anticipating the dynamic alterations productive of lesions, and by judicious use of surgical techniques, conservative medical therapy, and patient education, preventing the precipitation of a disabling disorder.

CLINICAL FEATURES

Definition

All attempts at a rigid definition of a cerebrovascular accident are unsatisfactory because of the large number of variations on the usual presentation. Implicit is the notion of destruction of central nervous tissue. Often of acute onset, the lay word "stroke" is aptly chosen, for the patient is struck down. However, the onset may be gradual, step-wise, or stuttering. Focal aspects may be present and represent the focus of destruction, but focal symptoms may be masked by the general effect of the lesion, by herniation, and by false localizing signs.

Two major pathological types of intracranial cerebrovascular lesions exist: *infarction* and *hemorrhage.* Each in turn is subdivided in two classes. *Infarcts may be ischemic or hemorrhagic; hemorrhages may be intracerebral or subarachnoid.* Ischemic infarction suggests acute deprivation of circulation, most frequently by thrombus, and sometimes by embolus, without early restitution of blood flow. Hemorrhagic infarction implies return of blood to the infarcted area with diapedesis and staining of tissue.

Hemorrhage which results from a disorder of small blood vessels such as that associated with systemic hypertension, begins in the intramedullary location of such vessels. Destruction of tissue is prompt and focal signs are common.

In contrast, subarachnoid hemorrhage begins in the subarachnoid space, usually as the result of an underlying anomaly. Tissue destruction is lacking and focal signs are commonly absent. Obviously, a hemorrhage arising from rupture of a saccular aneurysm into the subarachnoid space may extend into adjacent brain tissue producing focal signs. In that instance, it is referred to as a *meningocerebral hemorrhage,* emphasizing the initial meningeal hemorrhage.

Definition of a cerebrovascular lesion deals with its effect on nervous tissue and not with the vascular etiology. Infarction can occur without any necessary relation to underlying vascular occlusion by thrombus or embolus. The analogy with the coronary artery disease is justified, for in nervous system as in myocardium there may be infarction with or without vascular occlusion; and in cerebral as in coronary circulation, there may be occlusion with or without infarction.

Structural or Anatomical Aspects

With increased experience comes increased awareness of the intracranial manifestations of extracranial vascular disease. Because of this, because of the difference in presentation of intracranial and extracranial vascular disorders, and because of the difference in therapeutic implication, the distinction has been made between large and small cerebral vessels. In substance, what this means is that any comprehensive consideration of the anatomy of vessels concerned with cerebro-

vascular disorders must start at the aorta and include the entire rostral arterial tree. The ideal symmetry of vascular supply encountered intracranially is not present proximally. This is because of the difference of origin of the right and left carotid and subclavian arteries. The existence of an innominate trunk offers one unusual location for major vessel occlusion.

The vertebral artery on each side arises from the subclavian, courses through the foramina of the transverse processes of the cervical vertebrae to cross the arch of the atlas posteriorly, enter the skull through the foramen magnum, give rise early to the anterior spinal artery—an unpaired median vessel which receives a contribution from each vertebra and is joined by an ascending branch at about the eighth cervical segment—and then fuse at the pontomedullary junction to form the basilar artery. Stenosis of the subclavian artery proximal to the origin of the vertebral artery may, through hemodynamic mechanisms, siphon blood from the vertebrobasilar system in a retrograde fashion, producing the so-called subclavian steal syndrome.

The carotid arteries arise asymmetrically, the right taking origin from the innominate, the left arising directly from the arch of the aorta. Bifurcation occurs at the level of the thyroid cartilage into an external and internal branch. The internal carotid enters the foramen lacerum, courses through the bony carotid canal, and turns into the skull at the carotid foramen. It forms the loop of the siphon in the parasellar region, and divides into its terminal branches—the middle and anterior cerebral arteries. The ophthalmic artery, the most proximal branch of the carotid, supplies the circulation to the globe, and is an important anastomotic channel with the circulation of the external carotid via the angular and internal maxillary arteries. The anterior choroidal branch of the internal carotid artery nourishes the medial temporal lobe and the medial basal ganglia. The posterior communicating artery courses from the carotid to the homolateral posterior cerebral artery which is a terminal branch of the basilar artery.

The basilar artery provides circulation to the cerebellum, by way of the 3 long circumferential cerebellar arteries, and to the brain stem by perforating and short circumferential branches.

Anastomotic channels from external to intracranial circulation exist around the foramen magnum from the occipital branches of the external carotid artery. The 3 major cerebral arteries—the posterior cerebral, middle cerebral and anterior cerebral—anastomose with each other at their terminals just as the cerebellar arteries anastomose one with the other at the junction of the inferior and superior cerebellar circulation.

All discussions of the vascular distribution are predicated on an idealized scheme from which there is usually significant individual variation (fig. 1).[1] The circle of Willis has been found to demonstrate a large number of variations. Localization of a lesion with respect to the distribution of an individual vessel is based on the commonly accepted scheme. In addition to the occurrence of congenital variation of the pattern of the vascular tree, the stage is set for cerebral infarction by the occurrence of atherosclerotic narrowing of the arteries.

Arteriosclerotic stenosis has several sites of predilection. Interestingly, the major vessels are protected in their bony canals. It is quite uncommon for significant atheroma to occur in the course of the vertebral arteries through the transverse foramina, or in the carotid artery where it lies in the carotid canal. Commonly arteriosclerotic plaques are formed about 1.0 cm. beyond the division of the common carotid, and in the parasellar region. The intracranial portion of the vertebral artery and the basilar trunk may be involved anywhere along their course. Occasionally exuberant deposits of atheromatous material cause massive enlargement of the basilar artery, while simultaneously narrowing the lumen. Fusiform dilatation of the vessel occurs, often with associated stretching of adjacent nerves. Irritative phenomena, such as tic douloureux, hemifacial spasm, and tinnitus occur. Only rarely do these fusiform aneurysmal dilatations rupture, in contrast to the developmental saccular aneurysm. Calcification of major arterial trunks may be evident radiographically. This morphological observation should not be equated with great vessel insufficiency.

Dynamic or Physiological Defects

On the background of structural anatomical abnormalities, a dynamic event must occur to precipitate a stroke. It is the dynamic disruption that accounts for the production of a stroke at a given time. Some of these events, such as the dislodging of an embolus from a heart valve or atherosclerotic plaque with propulsion into the cerebral circulation, may be apparent. Others are less obvious and should be assiduously sought. Usually these relate to the production of in-

[1] Reproduced from *Neurology* by Simeon Locke, M.D. with permission from Little Brown and Company, Boston, Mass.

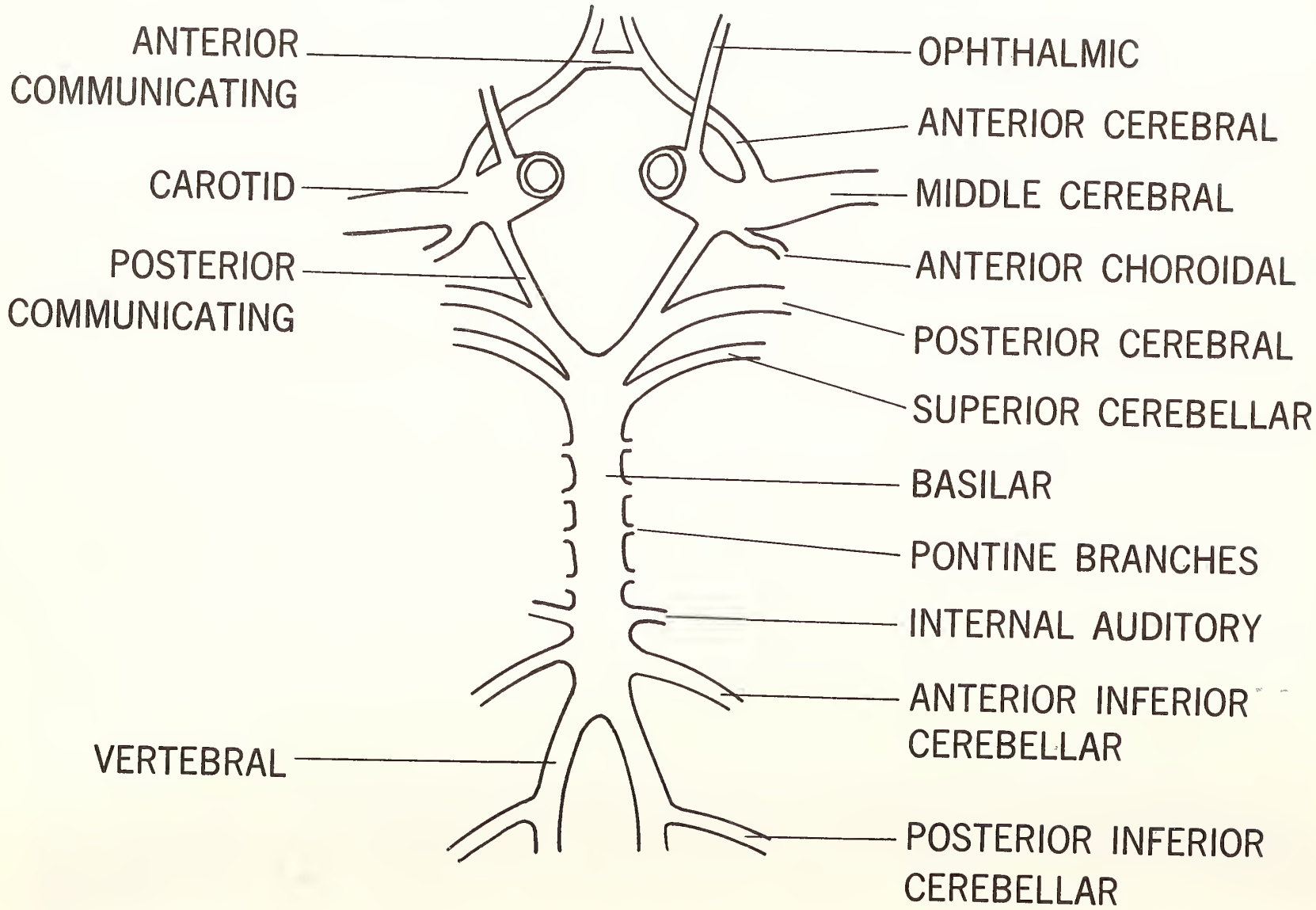

FIGURE 1.—Idealized diagram of the circle of Willis.

farction as a precipitating event, for hemorrhage is less common. Admittedly, increase of intracranial tension is hazardous in the presence of a congenital anomaly or of morphological changes of small vessels associated with systemic hypertension. These changes are thought to consist of microaneurysms, which are no different in their response to an increase of intraluminal pressure than the congenital anomaly.

Infarction may be precipitated by even minimal reduction of cerebral blood flow when the anatomical substrate has produced a marginal circulation. Reduction of blood pressure, decrease of cardiac output, diminution of circulating blood volume, anemia, or increase in blood viscosity may represent the critical change that precipitates infarction. Clearly, measures should be employed to prevent such occurrence. In the face of an accomplished infarct or of a stroke in evolution, investigation should be undertaken to exclude an occult hemorrhage, underlying myocardial infarction, blood dyscrasia, dehydration, cardiac arrhythmia, or acute reduction in blood sugar.

Localization of Lesion

The combination of structural abnormality and dynamic disorder produces an infarct, the signs and symptoms of which reflect the area of infarction and not necessarily the structural abnormality of the vessel nor the dynamic precipitating event. Localization of the lesion is usually described in terms of the standard distribution of a vessel without necessarily the implication of the localization of the lesion in that vessel.

Representation of motor, sensory, and visual function in contralateral cerebral hemisphere, with such somatotopic organization that caudal structures are represented superiorly, is useful in delineation of a lesion. The wide distribution of functional representation on the cortex often means that a cortical lesion causes only mild motor, mild sensory, or mild visual disorder. In contrast, an infarction of internal capsule, at a point where motor, sensory, and visual fibers converge, characteristically produces a dense impairment of all 3 functions. The left cerebral hemisphere is dominant for language representation in about 95 percent of patients. Aphasia—a disorder of language to be sharply differentiatcd from dysarthria, a disorder of speech—indicates a lesion of the major hemisphere in or near the cortex surrounding the Sylvian fissure and third frontal convolutions. Posterior circuit infarctions produce brain stem and cerebellar abnormalities. Action tremor, titubant gait, scanning speech, and hypotonia indicate affection of the cerebellum or its pathways. Cranial nerve abnormalities contralateral to the hemiplegia, nystagmus, dysarthria, a Horner's syndrome, or bilaterality of signs including the extremely important Babinski response, signify affection of brain stem.

DIAGNOSIS

Great Vessel Insufficiency

Insufficiency syndromes can be likened to angina pectoris. They represent transient ischemic attacks insufficiently protracted to produce infarction. Symptoms are short lived, and complete restitution of function is the rule. Transient ischemic attacks are usually associated with a structural abnormality of a major vascular trunk. Unfortunately it is not always possible to predict the distribution of symptoms from the location of the vascular lesion. Nor is it possible to predict when one major vessel is stenotic, except when that stenosis results from trauma, for it is not unusual for several extracranial cerebral vessels to be simultaneously affected by arteriosclerosis. To further complicate matters, a single vessel may be involved at more than one site.

In the idealized situation, it is reasonable to anticipate that symptoms will represent the effect of insufficient circulation at the anastomotic terminations of the intracranial vessels—the low point of pressure (fig. 2).[2] A longitudinal band of tissue high on the cerebral convexity is the watershed between the middle and anterior cerebral arteries. A similar watershed exists posteriorly between the posterior cerebral and the other 2 cerebral arteries. The lateral margin of cerebellar hemispheres represents the boundary zone between posterior and superior cerebellar arteries, and the central pons represents the border territory of the basilar circulation.

As is evident, if additional structural lesions are present in other parts of the vascular bed, the distribution of symptoms may be quite different. A stenotic middle cerebral artery in the presence of carotid insufficiency may move the symptoms from shoulder and hip, the area supplied by the anastomotic circulation of anterior and middle cerebral vessel, to the bed territory of the middle cerebral artery itself. Numbness of the hand, weakness of fingers, or an aphasic abnormality of speech may now occur.

[2] Reproduced from *Neurology* by Simeon Locke, M.D. with permission from Little Brown and Co., Boston, Mass.

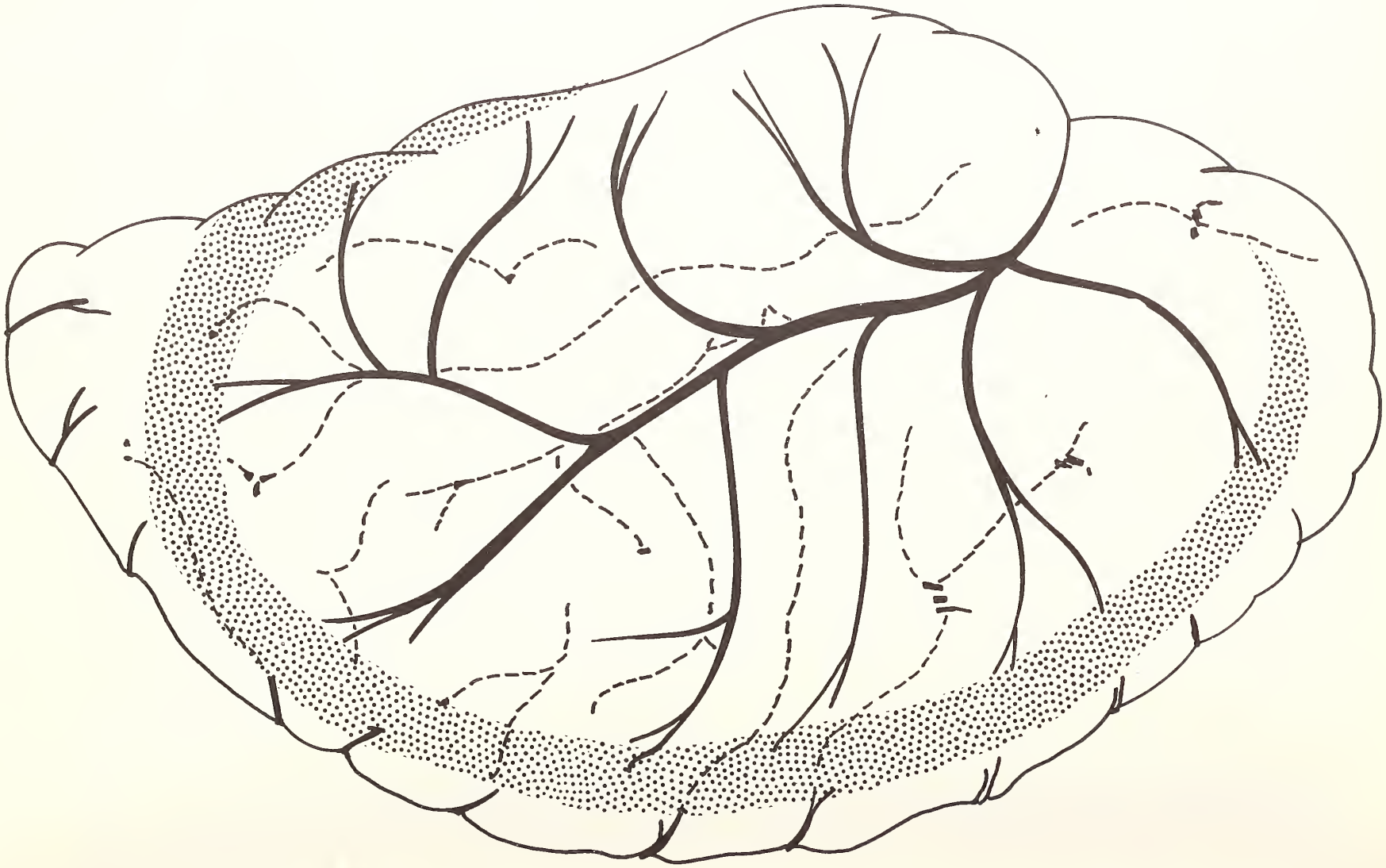

FIGURE 2.—Distribution of border zone infarction resulting from great vessel insufficiency.

Clinical signs of the obstructive lesion and of the attendant collateral circulation should be sought in the examination of patients with a history of transient ischemic attacks. A bruit over the bifurcation of the carotid artery, not transmitted from the base of the heart, usually signifies an underlying obstructive lesion. It has been estimated that bruits are heard only when the stenosis is greater than 50 percent and less than 85 percent of the arterial lumen. Palpation of the carotid artery in the neck may be misleading for it is the common carotid that is most readily felt. The internal carotid artery can be felt in isolation only by palpating behind the posterior pharyngeal pillar. Even in the presence of complete obstruction above the palpating finger, a pulsation may be felt which on occasion is more substantial than the pulsation of the contralateral, normal side. This results from the reflected pressure wave produced by the obstruction.

The external carotid vessels should be routinely palpated as they may give indication of collateral flow. When this occurs around the eye, proptosis and an orbital bruit may occur. This bruit must be distinguished from the retroorbital bruit of stenosis of the internal carotid artery as it lies adjacent to the sella. If a stenosing lesion exists below the level of the ophthalmic artery, reduction of pressure in the retinal circulation may occur. Ophthalmodynamometry, employing a spring loaded dynamometer, allows quantitation of retinal artery pressure. Clinically, however, the same information may be gained by gentle pressure on the globe with a thumb or finger while the ocular fundus is being observed. With a little experience, comparison of the amount of pressure needed to induce diastolic pulsation can be made from side to side. Bruits should be sought over the subclavian artery bilaterally, and the brachial artery blood pressure should be compared in each arm. These maneuvers will help exclude proximal lesions affecting cerebral circulation. More specialized techniques such as thermography or the use of carotid compression during electroencephalographic observation, may be employed, but are rarely absolutely necessary for accuracy of diagnosis.

In the final analysis, decision about the existence of an accessible obstruction must depend on arteriographic visualization. If this is to be undertaken, it is well advised to visualize all 4 major cerebral vessels. The technique employed must rest with the performing physician. Retrograde brachial catheterization, retrograde femoral injection, retrograde carotid techniques, and direct aortic puncture have all been employed.

Cerebral Infarction

Diagnosis of cerebral infarction is at best presumptive, for no single diagnostic tool allows absolute differentiation from neoplasms or from other vascular lesions.

In general, onset is abrupt, particularly when the structural deformity resides in a small vessel. Characteristically it is without associated pain and without conspicuous alteration of the spinal fluid. However, appearance may be gradual or stuttering, particularly when the lesion results from obstruction in a large arterial trunk. Antecedent headache is not uncommon, presumably as a manifestation of vascular dilation associated with development of collateral circulation. Finally, spinal fluid may be conspicuously abnormal, containing cells, blood pigment, and marked elevation of protein if there is marked necrosis or when the infarction is hemorrhagic.

Indeed, the distinction from frank cerebral hemorrhage may be impossible. Meningeal signs, which may reflect the alteration in spinal fluid, can also be produced by the brain swelling that follows infarction. A hemisphere lesion may mimic a brain tumor in its progression during the first several days of evolution.

The patient who arrives at the hospital alert, free of headache, and with clear, colorless spinal fluid under normal pressure, may, during the ensuing several days, complain of headache, become drowsy and ultimately comatose, develop meningeal signs, and exhibit xanthochromic, cellular spinal fluid with an elevated protein content under increased pressure. With resolution of the infarction, this progression is reversed.

Intracranial Hemorrhage

The distinction of subarachnoid from intracerebral hemorrhage, or even of intracranial hemorrhage from infarction, may not be possible. In general, headache is associated with intracranial bleeding. When headache antedates paralytic signs and meningeal manifestations are prominent, subarachnoid hemorrhage should be suspected. When paralysis precedes headache, the presumption of an intramedullary location of the hemorrhage is justified. Elevation of spinal fluid pressure, papilledema, and appearance of blood in the lumbar theca are to be anticipated. All may be absent, however. The appearance of a subhyaloid hemorrhage in the ocular fundus is often useful in the recognition of a subarachnoid hemorrhage.

The association of a systemic disorder which predisposes to small vessel disease may argue in favor of an intracerebral hemorrhage, but obviously the presence of systemic hypertension does not preclude the simultaneous existence of an aneurysm which has ruptured. In fact, the increased frequency of association of pheochromocytoma and intracranial vascular anomalies should be recollected. The distinction between a subarachnoid and intracerebral hemorrhage is more than academic, for on occasion vascular anomalies are readily accessible and amenable to surgical intervention. Only rarely is a primary hypertensive hemorrhage subject to the same approach.

Herniation

Any disorder of intracranial contents which causes increase in intracranial pressure sets the stage for herniation. Necrotic brain tissue following infarction or hemorrhage can shift from one compartment to another through a dural opening. Herniation of the cingulate gyrus beneath the falx, herniation of temporal lobe through the incisura of the tentorium, and herniation of brain stem and cerebellum through the foramen magnum may occur.

The clinical importance is twofold. First, the production of brain stem signs by compression and by secondary Duret hemorrhages may cause inaccurate localization of a lesion. Second, and more important, is the almost invariable fatal outcome once herniation has occurred.

Accordingly, *lumbar puncture, unless absolutely essential for diagnosis, should not be thoughtlessly undertaken when signs of intracranial hypertension are present.*

TREATMENT

Great Vessel Insufficiency

The management of the patient with acute ischemic attacks consists of stabilizing the hemodynamic factors that threaten to precipitate cerebral infarction.

In the impending stroke, bed rest with the head lower than the level of the heart, support of blood pressure and circulation, and intermittent utilization of carbon dioxide inhalation are to be recommended. Seven percent carbon dioxide in oxygen has been demonstrated to increase cerebral blood flow by 100 percent. Inhalations 10 minutes during each waking half hour until symptoms are stabilized, are effective in the management of a threatened infarction.

Long-term management includes measures to avoid postural hypotension and use of 9-alpha-fluorohydrocortisone with elastic stocking or an abdominal binder. Hot baths and straining at stool should be interdicted, as the former dilate the cutaneous and muscular vascular bed, allowing blood to pool when the patient rises from the tub, and the latter through the mechanism of the Valsalva maneuver, reduces cardiac output. In patients with diabetes, hypoglycemia must be avoided. Patients on treatment for hypertension should not be allowed to have precipitous or erratic fall in blood pressure.

If *anticoagulation* ever has a role in the management of cerebrovascular disease, it is in the treatment of the recurrent ischemic attack when surgical therapy cannot be undertaken. The hazards of anticoagulation, however, constitute a significant difficulty in their utilization.

If *surgical correction* of the underlying structural abnormality can be effected, it is to be recommended. The persistence of symptoms following reconstruction of a single vessel is not uncommon; it is well, therefore, to undertake repair of as many accessible lesions as possible in an effort to support collateral circulation.

Cerebral Infarction

The management of a cerebral infarction falls into 2 categories, the acute phase and the long-term management.

Early in the course of treatment many of the techniques employed in the management of recurrent ischemic attacks and impending stroke are used. The patient is kept in bed with the head low. Maintenance of blood pressure and utilization of carbon dioxide inhalations help facilitate cerebral circulation. If drowsiness, stupor, or coma have supervened, techniques utilized in the management of these states are employed.

Nursing is best performed with the patient in the prone position in order to exploit the natural inclination of the trachea and facilitate postural drainage. Frequent turning and attention to pressure points will help reduce the risk of decubitus ulceration. A pulsating air mattress is excellent if available. Elastic stockings employed to reduce the risk of phlebothrombosis should be removed for 20 to 30 minutes 3 or 4 times daily.

Catheterization is best avoided if possible. If mandatory, condom drainage reduces the hazard of infection.

Indwelling catheters, if employed at all, are best used in association with tidal drainage. This allows instillation of mild antiseptic fluid into the bladder, and permits periodic complete emptying. Oral acidifying agents help reduce infection with urea splitting organisms, and usually can be given without the risk of inducing metabolic acidosis. Prophylactic antibiotics for the treatment of urinary or pulmonary infection are best avoided. Should infection develop, the organism must be isolated, sensitivities identified, and the appropriate antibiotic employed in adequate dose for an adequate period.

Hypostatic pneumonia is best treated by precluding its development. The risk of aspiration pneumonia should be reduced by avoiding oral or nasogastric feedings during the early days of treatment. Nasogastric feedings which permit oral nutrition, medication, and hydration can be used with profit toward the middle of the first week following infarction. Stomach contents should be aspirated. Only if there is no significant residual should a feeding be given. A 2-hour schedule of 150 to 200 c.c. of high protein nutritious fluids, clear broths, and dextrose and saline proves quite satisfactory.

Gentle passive physical therapy may be started with profit quite early following a stroke. Prognosis of the outcome during the acute period is frequently difficult. A rough guide of functional recovery can be obtained by the appearance of spasticity. The longer a paretic limb remains flaccid, the worse the outlook. Spasticity appearing by 9 days usually predicates some degree of functional return.

Long-term management has as its goal the restitution of independence and self-sufficiency. Aggressive active physical therapy should be supplemented with braces and prostheses that help overcome residual difficulties. Speech retraining has a role in aphasic patients. Unfortunately, the recovery following a cortical aphasia is usually inadequate despite extensive efforts at retraining. Recovery following a subcortical aphasia often occurs even without special procedures.

Environmental manipulation cannot be overemphasized in the long-range management of a patient with cerebral infarction. On occasion, ramps can be used to replace steps with profit. The hazard of sills and scatter rugs to the individual with a spastic gait are obvious. Low beds and firm chairs are often helpful. Judiciously placed supports in the bathroom facilitate independence at toilet. Walkers and canes are frequently useful. Baths are often best performed while sitting on a low metal stool in tub or shower. An overhead trapeze may be used at home just as in a hospital bed.

Even wearing apparel may be adjusted to facilitate dressing. Elastic shoelaces and waistbands, zippers on shoes, and clip-on or elastic mounted neckties allow dressing even when one hand is clumsy. Leather soles in preference to the friction producing rubber or composition are preferred by many patients with a spastic circumducting gait.

Cerebral vasodilators such as papavarine or nicotinic acid have as little role in the long-term management of a completed infarction as do anticoagulants. Reconstructive surgery, if infarction results from extracranial stenosis or occlusion, should be considered only after the infarction has stabilized and maximum recovery has occurred. Even then it is paramount to remember the procedure will have no effect on the existing lesion and will be useful, if at all, only in the prevention of further episodes.

Intracranial Hemorrhage

The medical treatment of intracranial hemorrhage is quite similar to that employed in the treatment of acute infarction. Because intracerebral hemorrhage is often associated with systemic hypertension, treatment directed at the systemic disorder is a common adjunct to the treatment of intracranial hemorrhage. One hope is that by judicious reduction of arterial pressure, the liability to recurrent hemorrhage will be reduced.

Headache, which is a frequent accompaniment, should be treated symptomatically. If agitation is present, mild sedation is to be recommended. Customarily, however, it is best to avoid sedation as periodic evaluation of alteration in mental status will offer the most sensitive guide to fluctuations of neurological state. Sedation may deprive the examiner of this parameter.

When intracranial hemorrhage is a manifestation of a ruptured aneurysm treatment may include surgical management. Often supportive medical care is necessary for a period of several days to several weeks. In this situation, generous use of sedative medication has a distinct role. If the level of consciousness can be maintained so that the patient drowses throughout the day, but can be wakened easily for fluids, meals, coughing, and nursing care, patient anxiety is reduced and medical management of the aneurysm facilitated. Recurrent lumbar drainage of spinal fluid is no longer considered a valuable procedure. Intracranial aneu-

rysms have an alarming way of bleeding a second time during the first 3 weeks following initial hemorrhage. The hazard of a recurrent rupture is great and often terminates fatally.

Decision, therefore, should be made early in the course of the illness as to the advisability of surgical intervention. In the absence of clinical lateralization, bilateral angiography is usually performed in the hope of demonstrating a single aneurysm. If no aneurysm is visualized—for arterial spasm following acute rupture is not uncommon—it may be necessary to repeat the procedure after an interval of some days. If several aneurysms are visualized, the decision about the responsible lesion may be difficult.

Surgical procedures include ligation of the carotid artery in the neck, ligation of the pedicle of the aneurysm, isolation of an arterial segment on which the aneurysm arises, and coating of the aneurysm with plastic or wrapping it in muscle. The choice of procedure must rest with the surgeon and is based in part on the accessibility of the anomaly as well as on the general condition of the patient.

SUMMARY

Cerebrovascular disorders are of increased frequency of occurrence in the older age population. They consist of infarction and intracranial hemorrhage.

Infarction may be hemorrhagic or ischemic and may be caused by thrombus, embolus, or arterial stenosis, in conjunction with some dynamic factor that produces decreased cerebral blood flow. *Hemorrhage* may be subarachnoid from a congenital anomaly, or intracerebral as the result of small vessel disease which is usually indicative of a systemic disorder such as hypertension.

Diagnosis depends upon localization of the lesion in conjunction with evaluation of systemic factors and laboratory measurements.

Treatment during the acute phase is largely supportive and expectant. Long-range management is directed toward restitution of functional independence. Vigorous efforts should be directed toward recognizing the transient ischemic attack and managing this aspect of cerebrovascular disease prophylactically.

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CLINICAL GEROPSYCHIATRY

By

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The field of geropsychiatry includes the study of the psychodynamics and psychopathology of senescence and the treatment of psychological disorders associated with senescence. These disorders are either nonspecific (i.e., found also in other phases of life) or specific (i.e., due to factors specifically associated with senescence). In the latter case, senescence itself acts as a trauma or precipitating factor.

PSYCHODYNAMIC CONSIDERATIONS

Senescence as a *phase of human development* differs from previous phases in two important ways. First, the end of senescence is not followed by the beginning of a subsequent developmental phase. Second, late life is characterized by a series of important losses. Biologically, there is decreasing vitality and energy production and the occurrence of specific age-related changes in organ systems. Psychologically, there is declining effectiveness and speed of the capacity to take in sense data, to process this information, to evaluate its significance, and to carry out motor tasks. In the interpersonal realm, there is a constriction of the circle of relatives and friends. Socioeconomically, there is declining income, status and prestige.

The Concept of Dynamic Equilibrium

If health is defined as a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity, few people could be considered healthy for any length of time. Stresses and conflicts of everyday life affect us continuously and may interfere with our sense of well-being. As a matter of fact, a certain amount of stress and conflict is probably desirable in that it stimulates growth and maturation through crisis-resolution.

From a dynamic point of view, we may consider a person healthy if it is anticipated that his coping with stress is likely to be successful. The subjective experience of being involved in a struggle with the anticipation of a successful outcome is the sense of confidence.

Although distress and hardship may interfere with current well-being, a state of disease does not necessarily exist. Disability and disease develop when the coping mechanisms of the individual are taxed beyond capacity. Thus, the conditions for health and illness do not exist either in the organism or in the environment, but in both at once (Engel, 1962). The establishment and maintenance of a dynamic equilibrium between oneself and the environment is the hallmark of health.

The capacity for *coping with stress* (the range of capacity and the types of defenses that are chosen) is a function of that part of the psychic apparatus which is called the *ego*. The resourcefulness, strength and maturity of the ego-organization determines, to a large extent, the degree of success in coping with stress, trauma and loss. Any time that the organism over-extends itself in its attempts toward homeostasis and mastery of novel situations, we can speak of a crisis. Whether or not a particular crisis will be resolved depends, by and large, on the potential of the ego for growth. At the same time, crisis resolution results in further growth of the ego. We can describe the ego in objective terms, for example, by observing an individual's manner of coping with stress and loss, his mastery of novel situations and the objective signs of success as well as the subjective sense of satisfaction with regard to previous life phases and activities (marriage, parenthood, work, etc.).

The aging individual has to cope with multiple losses that often interact and accumulate in the manner of a vicious circle—at a time when the physical and mental energy needed for effective coping is decreasing. This has two implications.

First, usual ways of coping may have to be replaced by new techniques of adaptation. Active mastery, for example, may be replaced by acceptance which implies a process of review, reevaluation and reappraisal leading to an internal reorientation to the world and to oneself.

Second, the triad: decreased energy, multiple stresses and losses and the need for new adaptational techniques point up the importance of environmental support for the aging person. This support includes a great variety of measures: *medical* (drugs; prosthetic devices; prescriptions for alterations in usual activities, such as diet, sleep, exercise); *psychological* (the removal of unduly stressful stimuli; creation of an optimal physical environment; proper stimulation of mental and neuromuscular functions, etc.); *interpersonal* (counteracting isolation; promoting a sense of

dignity and self-esteem); *economical* (providing basic resources such as food and shelter); *legal* (protective services), and so on.

Psychological Reactions To Stress and Loss

Fear is the normal emotional reaction in response to impending injury or damage. Anxiety represents the danger signal in response to stresses that arise from within and are anticipated to cause conflict and distress (e.g., loss of control over unacceptable impulses). Grief occurs when damage or loss actually has taken place. The danger, injury or loss which is anticipated, and to which the individual is reacting, may be either actual (real) or imagined (existing in fantasy only). The more a person reacts to imagined dangers and losses, the more the psychological capacity of reality evaluation is impaired.

In a neurosis there is only a mild to moderate impairment of contact with reality, while in a psychosis the impairment is severe or total. Thus, a psychotic patient may live entirely in a fantasy world. A number of aged individuals tend to withdraw from reality and to retreat into their inner selves in order to "live off" their memories. In senility (advanced senile regression), for example, there is frequently a complete break with present reality, the patient being totally engrossed in his past. A withdrawal into fantasy is the final outcome of a long process—a process which frequently begins with the experience of significant losses.

Since in old age the experience of loss is inevitable, grief and depression are common in the aged. The normal emotional response to a loss which actually took place is a *grief reaction.* This should be distinguished from depression which, although difficult to define in exact terms, is generally considered as a pathological emotional reaction. A grief reaction may or may not merge into a depression; conversely, a depression may or may not be preceded by a grief reaction. A grief reaction involves a clear and conscious recognition of an actual loss. Following the initial emotional "shock," there is on the part of the bereaved person an increasing realization of the significance and all the ramifications of the loss; during this period there are recurring episodes of specific physiological sensations of distress and "waves of sadness." The feelings of grief and sadness are expressed verbally and nonverbally, e.g., through crying. Toward the end of the grief reaction (which may last from 3 to 12 months), there is a resolution which involves a redirecting of energy and interest toward new people, goals or activities.

When a close person is lost, the psychic energy invested in that person now has "no place to go." Eventually, the resolution of the grief reaction results in a reinvestment of this psychic energy.

Of course, when part of the self is lost (e.g., amputation), the resolution of the grief reaction may be more complex and more difficult and involves a form of inner realignment and reorientation. Adjustment to the latter type of loss is characterized by continuation of self-esteem, rooted in a religious or philosophical framework that views personal worth on the basis of one's intrinsic value as a unique person; by acceptance and integration of the limitation into a new self concept; and by finding new ways of maintaining closeness to others and realizing remaining potentials.

Under certain circumstances, a successful resolution may become difficult, or even impossible. This happens, for example, when the individual used to have mixed feelings toward that which was lost. The term ambivalence designates such a coexistence of both positive and negative feelings. Someone who has mixed feelings about having something, will also have mixed feelings about not having it. On this basis, the resolution of one's feelings concerning a loss may become too difficult, so that the grief reaction, being prolonged and gaining momentum, merges into a depression. In the aged, however, most depressions are characterized by feelings of apathy and "emptiness," rather than guilt. The reason for this is that an accumulation of many losses of all kinds leads to a depletion of the individual's inner resources.

Adaptive coping techniques imply a reestablishment of the equilibrium that was disturbed due to the loss. *Maladaptive* coping behavior leads to a vicious circle in that it tends to aggravate the very problem it is directed against. A number of maladaptive psychological reactions will be mentioned.

An individual may *deny* to himself and/or to others, that a particular loss has occurred, or that a particular problem exists. A cardiac patient, for example, may deny the seriousness of his condition or minimize the extent of the limitations imposed on him by the illness. If such a denial is excessive, it may seriously interfere with medical treatment.

Other people when faced with a loss or problem may develop a reaction of *anger and protest* ("Why does it have to happen to me?"). Certain individuals habitually tend to react with anger rather than with anxiety,

grief or guilt. One reason for this may be that anger is a more "comfortable" emotion than, e.g., anxiety and sadness. Anger may also provide one with the illusion that the aggressive counterattack will lead to retrieval of the lost object. This behavior is maladaptive when it keeps the individual from seeing the true state of affairs and when his angry and accusatory behavior alienates those around him. Anger usually seeks a scapegoat, and people who are hostile and aggressive by nature have little trouble finding something or someone whom they can blame for their predicament. When growing older, such a person may find it increasingly difficult to channel aggressive behavior toward active and constructive mastery; if so, there is even more probability of blaming the environment.

Some aged persons may respond to painful losses by *withdrawing* from the general area where the loss occurred; for example, withdrawing from activities following retirement or from people following an interpersonal loss. Such a person may feel that to be involved with or to be close to others involves too many risks, and he retreats into a state of protective isolation and insulation. This type of disengagement is maladaptive because it entails a move away from reality itself. Thus, the stage is set for a proliferation of inner fantasies and, perhaps eventually, senile regressions.

Finally, the individual may react to a loss by becoming *overly helpless and dependent.* A certain degree of increased dependency on others is normal and desirable following a loss or during illness. But excessive helplessness and dependency create new complications all of their own. If such undue helplessness is allowed to persist for some time, the individual's image of himself changes accordingly and rehabilitative efforts toward increased self-care will become more difficult. Not infrequently, the individual feels guilty about his behavior and he attempts to "pay" for his guilt by emphasizing his suffering. The environment may react to this with irritation and annoyance, recognizing the hostile clinging element in the patient's depression.

Feelings of guilt reflect the awareness of having fallen short in one's own eyes or in those of others or of having violated generally accepted rules. Feelings of shame and embarrassment represent the painful discovery of being exposed to the eyes of others. In illnesses that entail helplessness and in profound alterations of the body image (amputations, radical surgery, etc.), shame is a common emotion which requires particularly tactful handling.

MENTAL DISORDERS OF LATE LIFE

Psychogenic Disorders

A psychogenic disorder (neurotic, behavioral or psychotic) may persist from youth or early adulthood into old age, or it may appear for the first time in the aged person. The former are "carryover" conditions into old age and usually are modified to some degree by the aging process; hyperactive schizophrenic patients, for example, appear to do better with aging than schizophrenic patients who are underactive (Ehrentheil, 1964). Conditions that appear for the first time in old age are "age specific," e.g., an adjustment reaction of late life such as an identity crisis (Erickson, 1959).

Affective Psychotic Reactions

In psychotic disorders the disorganization of the personality is extensive, and adaptive efforts in the social, intellectual, occupational and religious spheres are ineffectual. Failure to correctly assess reality is a cardinal feature.

Involutional psychotic reaction is a depression (without previous history of depressions) and occurs usually in individuals of compulsive personality type. Some cases are characterized chiefly by depression, others by paranoid ideas. Delusions of poverty, worthlessness or having committed grave and unpardonable sins are frequent. Auditory hallucinations, e.g., accusatory voices, may occur. Sometimes the depression is manifested by intense preoccupation with diet, bowel movements or general health. Agitation or psychomotor retardation, loss of appetite, insomnia and constipation are frequent. An outstanding characteristic may be ambivalence and hostile dependency on another person which tends to provoke anger and rejection by the other. Regardless of the symptom picture, the disturbance in mood is the outstanding sign; hence, the phrase "affective disorder." Affective disorders are characterized by a marked disturbance of mood and a *secondary* disturbance of thought and behavior.

Manic-depressive reaction — Alternating, marked mood swings from depression to elation, remission and recurrence, comprise the essential features. The manic type demonstrates increased verbal and psychomotor behavior. Rapid flow of ideas may be noted. During this phase the individual may engage in unwise business deals and extramarital romances. The depressed type manifests depression of mood; psychomotor re-

tardation usually is prominent, but either agitation or stupor may occur.

Psychotic depressive reaction.—This is a depressive psychosis of psychogenic origin occurring in the absence of a history of previous depressions and without the specific involutional etiological factors. Thus, the psychotic depressive reaction of the aged is comparable in symptomatology and psychodynamic etiology to that found at any age. The psychodynamic background usually involves the experience of a loss, either real or imagined, which is not primarily age-specific (death of a parent, loss of a spouse, a disappointment in vocational aspirations, etc.). The premorbid personality may be characterized by neurotic patterns (e.g., neurotic depressive reaction) and/or by a personality disorder (e.g., dependent personality). The symptoms of the psychotic depression include profound affective disturbance: depression, hopelessness and guilt; delusions that are consistent with the affect; psychomotor retardation, agitation and, occasionally, auditory hallucinations.

Differential Diagnosis of Affective Disorders

Psychogenic vs. Organic.—The psychogenic affective disorders should be differentiated from the emotional disturbances that may secondarily occur in the presence of organic brain syndrome. This differential diagnosis can be complicated by the fact that the psychogenic depressive disorders may show memory and concentration difficulties. In organic brain syndrome the emotions are more shallow and labile, guilt is less prominent; the presence of focal neurological signs and the specific signs of organic brain syndrome serve as additional guidelines in the differential diagnosis.

Affective vs. Thought Disorder.—Sometimes it is difficult to differentiate mood disorders from schizophrenic reactions, i.e., when there are hallucinations, paranoid trends or when the mood and ideational contents are not congruent. In fact, the paranoid variety of the involutional reaction does, at times, emerge later as schizophrenia. In general, the predominance of affective symptoms, the absence of a primary thought disorder, the absence of inappropriate behavior and the premorbid personality characteristics are important considerations in this differential diagnosis.

Psychotic vs. Neurotic.—Psychotic disorders are characterized by loss of the ability to evaluate reality, by profound disturbance in interpersonal relations and self-concept, inability to function autonomously in the framework of society, and by specific signs such as delusions, hallucinations and suicidal tendencies.

Late Life Schizophrenia

Schizophrenic reactions are characterized by emotional, intellectual and behavioral aberrations. Reality testing is deficient. Incongruency between thought content and emotional response may be marked; there may be a diminution of affective response. Regressive behavior may be prominent and chronicity is common. Of the various types of schizophrenia, the simple, hebephrenic and catatonic forms are typical of the earlier years in life.

Paranoid Schizophrenia may appear as late as the middle adult years and leave the personality relatively intact, in contrast to other types of schizophrenia. Delusions of persecution or grandeur, ideas of reference, auditory hallucinations are common features. Paranoid schizophrenia is to be distinguished from paranoid state and from the paranoid delusions occasionally found in senile patients.

Paraphrenia.—Kay and Roth (1961) found that about 10 percent of admissions over 60 years of age had a schizophrenic-like disorder characterized by paranoid delusions and frequent hallucinosis. The impairment of purposeful action, changes in affect and deterioration in intellectual function usually associated with schizophrenic reaction were absent. Neither was there evidence of confusion and impairment characteristic of organic dementia. These patients survive for a long period of time; recovery is the exception and prolonged hospitalization is the rule.

The paraphrenic is most often single or widowed, and female, and has few close relatives. Over 40 percent of the cases were living alone when hospitalized (as compared to affective disorders of which only 12 percent were living alone prior to hospitalization). Few of the paraphrenics had children, and those with children had only limited contact with them. Good health was a common finding, but hearing loss was common. The deafness and the fact of having few relatives and a small family of origin contribute to the longstanding isolation characteristic of the paraphrenic.

Persecutionary delusions include ideas of being drugged, thoughts being read, mind or body being worked on by rays, machines or electricity and so on. Auditory hallucinations occur in 75 percent of the cases with threatening voices, jeering commentaries, obscenities, loud bangs, etc. The responsible parties

are often jealous, hostile neighbors. Hallucinations frequently occur at night, particularly those of an erotic type. These experiences are intermittent; behavior and thought-content in free intervals can be relatively undisturbed. However, the hallucinations are remembered and elaborated with absence of insight.

Once hospitalized, these patients do well, but as years go by their adjustment becomes more and more brittle. The psychosis may flare up as a result of a visit from relatives, initiation of leave plans or any disruption of routine.

Differential diagnosis.—The psychopathology of the disease and the particular set of predisposing factors separate paraphrenic from the organic and the affective disorders of the aged. It is a schizophrenic process with paranoid delusions and hallucinosis.

Since paraphrenia occurs in late life, the relationship of *organic cerebral degeneration* must be considered. The mortality rate in the paraphrenic group compared to the senile dementia group would seem to place them as separate entities. Organic deterioration may, of course, be superimposed on paraphrenia, and in this case, a careful and detailed anamnesis obtained from a relative or acquaintance will provide the data needed to differentiate this from a primary organic brain syndrome with secondary paranoid reaction. Also, when the persecutory delusions are superimposed on senile brain disease, the delusions usually are vague and judgment is seriously disturbed; there is early evidence of loss of intellectual capacity and the delusions are not persistent.

The loss of abstract attitude and reliance on concrete attitude have been presented as explanations for the thought disturbance in schizophrenia and early organic brain disease. The abstract attitude involves symbolism; it goes beyond the immediate aspect of the impression. A normal individual with an intact abstract ability can shift from one mental set to another.

The schizophrenic retreats to a less advanced level of mental integration and shifts from the abstract attitude to a concrete attitude (predicate logic, in which an associative link becomes an identifying link). Hallucinations and perceptualization of concepts are extreme degrees of concretization.

In the organic patient there is a disintegration of sensory, motor and mental processes with impairment of the abstract ability. The individual becomes more stereotyped, lacks initiative and spontaneity. It is especially when he is asked to perform tasks demanding choice or shifting of mental set that the loss of abstraction is revealed.

Paranoid Reactions.—The A.P.A. Diagnostic Manual (1952) defines paranoid reactions as disorders of thought, usually persecutory or grandiose, without the presence of hallucinations. A paranoid state is usually of brief duration although sometimes it becomes chronic.

Neurotic Reactions

The person suffering from a neurosis does not grossly distort reality nor exhibit great personality disorganization. Anxiety, either consciously felt or unconsciously controlled by certain defense mechanisms, is a cardinal feature of the neuroses. The anxiety arises from an "internal" threat such as threatened breakthrough into awareness of expression of unacceptable thoughts or impulses. The various defensive techniques (mental mechanisms) for handling this anxiety give rise to the neurotic disorders.

Types of neurotic reactions (American Psychiatric Association, 1952)—In an *anxiety* reaction the anxiety is not controlled by a defense mechanism; hence, the patient experiences a nameless dread. Neurotic anxiety differs from fear in that the anxiety arises in the absence of a specific external fear-provoking situation.

In a *conversion* reaction the impulse causing anxiety is converted into physical symptoms. This conversion of psychological conflict into physical symptoms decreases anxiety and often results in a "secondary gain" (a gain derived from the sick role).

Displacement of anxiety from one idea or situation onto a substitute or symbolic one is at the roots of the *phobic* reaction. The individual then attempts to control his anxiety by avoidance of the phobic situation.

Obsessive compulsive reactions are characterized by persistent undesirable thoughts or ideas associated with the compulsion to perform certain ritualistic acts. The person may realize the unreasonableness of his behavior but is compelled to perform the acts anyway.

In a *depressive* reaction, self-condemnation, guilt and depression partially relieve the anxiety. Absence of psychosis and lack of malignant symptoms differentiate the disorder from the psychotic depressions.

In a *dissociative* reaction, anxiety may result in apparent personality disorganization, and the unacceptable, repressed impulse may be channeled into such symptoms as depersonalization, stupor, fugue, amnesia, dream state and somnambulism. The disturb-

ances in consciousness may be of such a degree that at times it is difficult to draw the line between neurosis and psychosis.

Neurotic Symptoms in Senescence

Of the various neurotic disorders, *depression* appears to be the most common one among the aging. Neurotic depressions in late life are frequently associated with hypochondriasis (bodily over-concern) and somatization (relative emphasis of the physiological concomitants of depression and anxiety). Many aged individuals suffer from brief mild depressive episodes which are relatively nondisabling. Because of the frequent hypochondriasis and somatic symptoms (fatigue, abdominal and cardiorespiratory distress, etc.) these patients are usually seen by the family practitioner.

Obsessive compulsive symptoms occur less frequently than depression but more often than other neurotic reaction patterns. Obsessive thoughts may be manifested by repetitive preoccupations, frequently of a hypochondriacal nature. Obsessive symptoms usually occur or are exacerbated in the presence of depression; treatment of the underlying depression leads to amelioration of the obsessions (Post, 1965). Compulsive behavior may become less prominent in senescence, especially if the compulsive acts require the expenditure of considerable energy. The compulsive acts may then be replaced by other acts requiring less energy expenditure; or, they may be replaced by obsessive thoughts.

On the other hand, compulsive ritualistic behavior may become relatively stronger in old age. In some cases, this is perhaps related to an increased need for, and preoccupation with, maintaining a sense of control —control over one's biological functions, one's emotions and impulses and one's immediate environment. In fact, it is difficult to draw a clear line between compulsive behavior and age-related "rigidity." Most compulsive rituals and ceremonies in the aged are probably adaptive in that they enhance a subjective sense of control and order. In view of this, the physician is likely to encounter many instances where it is useful to strengthen compulsiveness at the expense of less adaptive defenses.

The classical *conversion* reaction is relatively rare in any age group, including the aged. Quite common, however, is a *hysterical exaggeration* of physical symptoms. The dramatic or histrionic "playing up" of one's physical distress frequently is a primitive or disguised call for help or attention. At other times, it represents an attempt to make others feel guilty and thus to coerce the environment. The secondary gain of neurotic symptoms refers to the advantages that secondarily arise from the neurotic illness or the sick role. Primary gain is an intrapersonal gain; the reestablishment of a psychological equilibrium. Secondary gain is interpersonal.

This phenomenon can also be observed in some cases of phobic reaction. A patient may, for example, have a fear of staying by himself at night. A deeper, underlying (unconscious) fear of death is being displaced onto an external symbolic substitute fear: the fear of being alone. This phobic displacement leads to the primary gain (remaining unaware of death-anxiety); but once the phobia is a *fait accompli*, other people may be moved to stay with the patient (secondary gain).

Differential Diagnosis

Anxiety and Depression.—Classical anxiety reactions (with "free floating" anxiety) appear to be rather uncommon in the aged. Instead, anxiety is frequently manifested by symptoms of somatic distress. The source of anxiety is more likely to be an anticipation of loss (a threat to security) rather than the emergence of unacceptable drives and impulses (guilty fear), as in younger individuals. In the aged, this type of anxiety is closely related to depression (Zetzel, 1965). Thus, anxiety concerning loss of external supplies and depressive apathy are psychodynamically related and frequently coexist in the aged.

Psychological and physical symptoms.—The appearance of anxiety and depression in an aging individual with an absence of psychiatric illness in the past history and without any apparent psychological or interpersonal precipitating factors should alert the physician to the possibility of an early serious systemic illness, e.g., a malignancy. Psychological symptoms may arise before the specific manifestations of a systemic illness, and in such a case a thorough and complete physical examination is, of course, indicated.

Conversion, psychophysiologic reactions, somatization and hypochondriasis.—The classical *conversion* reaction involves the conversion of psychological conflict into physical symptoms. These physical symptoms are in the nature of a change in the functioning of sense organs or the musculoskeletal system. The physical symptoms do not reflect organic illness, nor do they correspond to neuroanatomic structures and patterns. Instead, they are in keeping with the subjective

notions that are a part of the patient's body image.

In *hysterical exaggerations,* physical illness is indeed present, but the subjective disability is dramatically emphasized and displayed and is out of keeping with the objective findings.

Psychophysiologic reactions differ from conversion as follows: they do not involve the symbolic expression of conflict; dysfunction or organic disease is present in one or more organs innervated by the autonomic nervous system; and there is no relief from anxiety, since the illness does not represent a defense as in the case of a conversion reaction.

Somatization involves a disproportion between the physiologic concomitants of emotions and the subjective inner experience, the former being more prominent.

Hypochondriasis essentially is a constellation of ideas (bodily over-concern) associated with an anxious or depressive affect; it may occur in the presence or absence of organic illness.

Obsessive-compulsive symptoms may have to be differentiated from the perseverations and stereotypical patterns of organic brain syndrome and schizophrenia. Characteristic for neurotic obsessions and compulsions is the inner sense of being compelled or driven. Some patients are clearly aware of this "ego alien" quality of the obsessive-compulsive symptoms. In organic brain syndrome and schizophrenia, the patient may or may not feel compelled to perform rituals, etc., but the ego-alien quality is usually not reported.

Personality Disorders

Internal discomfort and a sense of anxiety from within are lacking in these disorders, in contrast to the neuroses in which anxiety is paramount. Disturbing and/or maladaptive behavior patterns and interaction with the environment rather than neurotic or somatic symptoms are prominent (American Psychiatric Association, 1952).

Personality pattern disturbance.—The psychopathology of these disorders results in limited adaptability; under stress, a psychosis may even become manifest. An *inadequate* personality is characterized by inadequate responses to emotional and physical demands but is not grossly deficient on examination. The *schizoid* personality avoids close involvement with others and has difficulty in being normally assertive; he is autistic, seclusive and sometimes eccentric. The *cyclothymic* personality has an extrovert approach to life; alternating moods of elation and depression, though not of psychotic degree, are characteristic. The *paranoid* individual has certain schizoid characteristics as well as a tendency to utilize projection which results in suspiciousness.

Personality trait disturbance.—Compared with the personality pattern disturbances, individuals with this disorder demonstrate greater coping ability. Again, the neurotic elements are minor and personality disturbance is the major feature. The *emotionally unstable* personality is undependable and experiences markedly vacillating emotions. The *passive-aggressive* personality may be a passive-dependent type who is helpless and indecisive; a passive-aggressive type with stubbornness and passive obstructionism; or an aggressive type, reacting to frustration with irritation, tantrums or destructive behavior. The *compulsive* personality is inhibited, over-conscientious, rigid and lacks a normal ability to relax.

Sociopathic personality disturbances.—These individuals are often in conflict with dominant cultural values. Antisocial personalities benefit neither from experience nor punishment; they have no loyalties and show lack of responsibility and judgment. The *dyssocial* personality maintains loyalty to the code of his own social group and disregards the broader social values.

Personality disorders and senescence.—Personality disorders may improve or worsen in the course of the years. An individual with mild schizoid tendencies may feel relatively more comfortable in the loneliness of old age. On the other hand, a severely schizoid person may, in old age, become a recluse living in marginal circumstances.

An inadequate personality may feel quite contented about retirement (often even an early and forced retirement) because he no longer has to cope with the demands of work. Many inadequate personalities depend for their happiness on the support from welfare agencies.

The paranoid person may gradually decompensate so that finally the manifestations of paranoid schizophrenia become overt in late life.

The emotionally unstable person may react unpredictably or excessively to any of the age-specific losses.

Compulsive personalities who were able to use their compulsiveness adaptively and to their advantage may benefit, in old age, from this orderliness and regularity. On the other hand, if the emphasis used to be on rigidity and inhibition, the losses of old age may precipitate an involutional depressive reaction.

Disorders in the Presence of Brain Damage (Organic)

Organic brain syndrome constitutes the largest group of institutionalized older persons with mental disorders. The organic brain syndrome may be relatively uncomplicated or it may be accompanied by disorders of affect or thought. Since most of these patients have physical impairments, they present more problems in medical, psychiatric and social care than other groups of aged persons. Since complete recovery of patients with brain syndrome is unlikely, continued medical supervision and a protective environment are called for.

The syndrome may be acute (potentially reversible) or chronic (irreversible brain damage). The *acute* organic brain syndromes may be due to infectious processes (within the nervous system or elsewhere in the body), drugs, alcohol or poison, trauma, circulatory disturbances, convulsive disorders, disturbances of metabolism and neoplasms. *Chronic* brain syndrome may be caused by congenital anomalies, injury to the brain, and by diseases of unknown cause (multiple sclerosis, Pick's disease, etc.). In addition, all of the above mentioned causes of acute brain syndrome may also cause chronic brain syndrome.

In most cases, the existence of acute brain syndrome in the aged can be taken as presumptive evidence of simultaneously developing chronic brain syndrome. Serial attacks of acute brain syndrome often represent a step-like progression to the chronic form. Therefore, in each patient with an episode of acute brain syndrome, one should try to determine whether or not chronic brain syndrome is present as well.

Clinical Assessment.

Organic brain disorders are characterized by impairment of orientation, memory, intellectual functions and judgment; emotional lability is usually present. The manifestations may be mild, moderate or severe in degree. The clinical severity of organic brain syndrome depends, by and large, on the extent of structural brain damage. By no means, however, is there a one-to-one relationship between the severity of clinical manifestations and the findings at autopsy. Personal-psychological and social-environmental factors are intervening variables.

When diffuse brain damage develops slowly and environmental circumstances are supportive or when there is a minimum of stress, the individual may be able to compensate for functional loss with relatively little psychological upset. Good early education, high occupational and economic status and the early acquisition of socially acceptable patterns of behavior tend to "protect" against troublesome behavior. There may be excellent preservation of function, especially on a social level, even in the presence of rather severe brain syndrome. Social behavior may be so well preserved as to mask severe memory deficit and disorientation. (Group for the Advancement of Psychiatry, 1965).

Quantification of brain syndrome is possible by means of a standardized rating system derived from scores on a 10-point questionnnaire (Kahn et al., 1960). The responses to questions that test orientation for time, place and person, recent and remote memory, and general information identify those with organic brain syndrome, which is none to mild (0–2 errors); moderate (3–8 errors); or severe (9–10 errors). The questions are:

Where are we now?
Where is this place located?
What month is it?
What day of the month is it?
What year is it?
How old are you?
What is your birthday?
Where were you born?
Who is the president of the U.S.?
Who was president before him?

Rating methods such as those developed by Halstead (Halstead et al., 1963) and Reitan (Reitan and Reed, 1962; Reed and Reitan, 1963) may permit more precise measurement of brain damage. For the clinical diagnosis of brain syndrome, the following findings should be present:

Disorientation for time, place or person.
Impairment of immediate recall.
Deficits of recent and remote memory.
Weakening of intellectual functions as indicated by difficulty and errors in doing simple calculations or in recalling simple items of general information.
Defects of comprehension.

Consideration may also be given to such clues as apathy, emotional lability, focal neurological signs (e.g., aphasia, agnosia and apraxia), slovenliness or poor personal habits, and poor judgment not related to emotional disturbance.

Types of Organic Brain Syndrome (Group for the Advancement of Psychiatry, 1965)

Cerebral arteriosclerosis is a chronic brain syndrome associated with episodes of focal brain damage, frequently cerebral thrombosis or carotid artery occlusion. Vasospastic episodes, cerebral anoxemia, hypotensive crisis in hypertensive patients or cardiac failure may also be responsible. Cerebral hemorrhage rarely causes chronic brain syndrome because only few patients survive the acute episode.

Diffuse brain damage is apparently necessary in order for signs of chronic brain syndrome to develop. A single cerebrovascular attack usually causes signs of focal rather than diffuse damage unless systemic disease contributes to diffuse brain damage through its effect on blood supply or metabolism. Several strokes may occur before chronic brain syndrome is evident, in spite of the signs indicating focal brain damage.

Senile brain changes are etiological factors in chronic brain syndrome in the absence of focal neurological signs and of a history of stroke. In contrast to cerebral arteriosclerosis, senile brain disease usually occurs after the age of seventy. Its onset is often insidious; its progression may be characterized by ill-defined emotional disorders or by overt depression. The clinical sub-types of "senile psychosis" can be classified as follows:

Delirious.—An acute brain syndrome occurring in a patient with chronic brain syndrome. Most of these patients are physically ill (metabolic disturbances, dehydration, malnutrition, trauma, exhaustion, etc.).

Depressed and agitated.—Depressed patients with agitation, disorientation and anxiety; delusions and hallucinations may be present.

Paranoid.—Patients with chronic brain syndrome who are suspicious, hostile and who blame others. There are poorly organized delusions which may be persecutory or self-aggrandizing.

Simple deterioration.—These are uncomplicated cases of brain syndrome with memory loss, diminished emotional responsiveness, disorientation, wandering and nocturnal restlessness.

Presbyophrenia (literally: "old mind").—Refers to patients with confabulations who in spite of gross memory defects, retain superficially good social habits.

Psychological Reactions with Organic Brain Syndrome.

Psychogenic disorders may or may not be associated with disorders caused by impairment of brain tissue. Clinical conditions may be encountered which are properly diagnosed as: organic brain syndrome due to cerebral arteriosclerosis, associated with neurotic depressive reaction; or associated with psychotic depression; or associated with behavioral disorder.

The patient with cerebral arteriosclerosis is usually aware of loss of physical and mental powers, and reacts to his losses with feelings of depression. Depression is a common reaction to severe or threatening illness of any kind, and it is especially noticeable in those whose personal integrity is threatened by the effects of brain damage. Attempts to repair, ward off or defend oneself against the threat of disintegration are sometimes facilitated by *anosognosia.* This is the term applied to brain damage in which the patient "does not know and knows not that he knows not." In such cases even major physical defects, such as hemiparesis, may not come to the patient's conscious awareness.

The psychotic reactions most commonly seen with chronic brain syndrome are paranoid states and depressions with or without agitation. Involutional types of depressions with guilt feelings, self-depreciation, expressions of unworthiness, rumination over previous failures, exacerbation of hostility toward relatives, suicidal tendencies, etc., rarely occur in conjunction with CBS. It is almost as if a brain-damaged person does not possess the resources needed for the elaboration of complex psychological modes of reaction. Nevertheless, under the pressures of illness and pain, suicidal tendencies may occur even in the presence of brain syndrome. This risk is especially great in elderly male patients.

THERAPY: GENERAL ASPECTS

The Role of the Physician

Goals of Treatment

The characteristics of the illness, the patient's environment (family, economic resources, etc.) and the aging process itself usually determine what are rational treatment goals. Sometimes the primary goal may be to provide relief for the relatives rather than for the patient, if his condition is essentially intractable. On the other hand, some aged patients can be helped by insight therapy, when, for example, deterioration is minimal, ego strength is adequate, the patient is motivated and adequate environmental support is present.

Usually treatment goals with elderly patients are limited in scope. Once this has been realized and accepted by the physician, he is likely to find that geriatric therapy can be quite rewarding in terms of obtaining tangible improvement in the patient as well as professional satisfaction for himself. Therapeutic failures with the aged do not by any means have to be more frequent than in younger patients. Many failures are caused by prematurely abandoning the therapeutic program.

A realistic approach in treatment involves not only a desire to help and to alleviate human misery, but also a cool objective appraisal of the goals to be attained. Excessive zeal, personal over-involvement or "rescue fantasies" on the part of the physician are sooner or later detrimental to effective treatment. By maintaining a realistic approach to treatment goals, the emotional climate of the doctor-patient relationship is enhanced.

If, for example, the value of palliation is inflated to the proportions of a cure, the patient may become demoralized by disappointments. On the other hand, a steady downhill course in a patient's condition may tempt the physician to abandon any serious efforts at palliation. Avoiding either extreme, the physician should feel that as long as the patient remains alive, nothing can happen to him which cannot at least be mitigated.

When to Refer

Most aged patients have some form of emotional problem and many have a mental disorder. The majority of these patients are seen, diagnosed and treated by the general practitioner, and a minority are seen by a psychiatrist. The frequency of referrals, of course, depends on a number of factors including availability and accessibility of psychiatrists in the area, the physician's own knowledgeability in the area of geropsychiatry, the attitudes of the patient and his family, socioeconomic factors, etc. When, then, should a psychiatrist be called in? Psychiatric referral and consultation may be needed for two reasons—diagnosis and/or therapy.

Diagnostic referral.—Some questions and conditions likely to lead to referral are:

To what extent do psychogenic factors contribute to, or are responsible for, the physiologic symptoms that present themselves? (Psychophysiologic reactions, conversion reactions, depressive equivalent, hypochondriasis, etc.)

What are the effects of the patient's physical illness on his psychological functions? These somatopsychic reactions include, for example, grief reaction, reactive depression, excessive regressive behavior, paranoid reactions and acute confusional states.

Evaluation of patient's preoperative and/or postoperative reactions.

Diagnosis and differential diagnosis of such conditions as organic brain syndrome, senility, depression, paranoid states and behavior disorders.

Disturbing behavior: confusion, combativeness, suicidal tendencies, overt sexual acting out.

Referrals for treatment include—

Management of psychotic conditions that require electro-convulsion therapy.

Advice concerning disposition, e.g., admission to mental hospitals, commitments, release from mental hospitals.

Individual psychotherapy for selected patients such as reactive depression, identity crisis, life-long neurosis exacerbated by aging.

Group psychotherapy.

The Doctor-Patient Relationship

Geriatric practice involves a relatively large number of emergency situations; problems of scheduling (time, place, duration); problems related to the fact that the patient, although an adult, is very often a dependent on other members of his family; the frequently multigenerational nature of the problem; and the high degree of coincidence of organic brain disease and psychogenic trauma (Zinberg, 1964).

Essential to therapy is the establishment of a satisfactory relationship between physician and patient. This involves consideration of the role and position of both the patient and the physician.

Patient factors.—Due to age-related sensory decrements, intellectual impairment and slowing of central nervous system processes, the patient often has difficulty in cooperating with the physician during the anamnesis and physical examination. It may take him longer to comprehend and respond to questions; he is more likely to forget treatment instructions, etc. In view of this it may be necessary that the physician talk more slowly to the patient (not necessarily louder), that he repeat questions and instructions, and that he write down any advice and suggestions as well as the date of return visit.

Transference factors play a role in most interpersonal relations, including an ongoing doctor-patient

relationship. Only in insight-oriented psychotherapy is the transference analyzed; in other types of doctor-patient relationships the transference is left largely untouched. For that matter, such transferences can play a significant role and be a potent force in the patient's getting well or getting better.

Transference refers to the transferring of certain emotions, attitudes and expectations from persons in the patient's past life onto persons in the present (e.g., from the patient's father to the physician); or from one current life situation to another (e.g., hostility towards relatives being displaced onto the physician). Since the older patient often lives in the past, the physician may tend to be seen as a person in the patient's past. Thus, the patient may not be able to distinguish the physician as a real person from the physician as a transference figure.

Physician factors.—Younger physicians may have a certain degree of difficulty in understanding the experiences of their aged patient. The understanding of another person usually involves the mental process of empathy: a transient identification—imagining what it would be like to be "in the other fellow's shoes." For physicians who have not yet had the experience of being old, empathic understanding becomes more difficult. In addition, the physician may react with impatience and irritation when dealing with the communicative barriers commonly encountered in aged patients.

The counterpart of the transference in the patient is the phenomenon of countertransference in the physician. Countertransference is common; it may represent a counter role to the patient's transference roles and expectations. If the two roles are fitting and appropriate, the two participants in the relationship have something to offer to each other. An elderly woman patient, for example, may unconsciously regard the physician as "the son she never had." If the physician's behavior toward this elderly woman, in some way and at some time, contains elements dating back to the relationship with his own mother, then there may be a fit between mutual expectations and roles.

A countertransference, like a transference, becomes a problem in the relationship only when it contains relatively strong neurotic components or when there is an excessive degree of unconscious ambivalence. The possible existence of "gerophobic" attitudes on the part of the physician, or his own unresolved fears of aging and death, will make it difficult for him to approach disorders in the aged with a therapeutic attitude of enlightened detachment and rational compassion.

The obvious limitations in setting therapeutic goals and the lack of opportunity for modifying lifelong patterns of adaptation are added burdens. The cultural emphasis on youth and attractiveness may be a further handicap to him in dealing with aged or chronically ill individuals who have a host of signs and symptoms.

Finally, early emotional conflicts which existed between the physician and his own parents may be reactivated causing specific countertransference attitudes. In such cases effective therapeutic intervention is likely to be seriously handicapped. From a practical point of view, the physician then has two options: either refer the patient to a colleague or have counsel with himself regarding the nature and source of his own personal countertransference attitude.

It is important that personnel involved with care of the aged maintain an attitude which combines realism based on scientific knowledge with the humane desire to alleviate suffering. Only then is it possible to avoid the extremes of detachment on the one hand and overinvolvement on the other hand. As a rule of thumb, it is not wise to continue treating patients for whom one has either unusual likes or dislikes.

Optimal Physician Attitude

Respect and tact transcend the level of "techniques," a term which connotes the conscious application of methods. Tact depends on an intuitive grasp of human issues and a respect for other people which is inextricable from self-respect. A tactful approach involves respecting the patient's person and dignity. The physician must, while transcending the phenomenon of the pathological alterations that he is facing, relate to the patient as a whole person with respect. A patient may suffer painful loss of face when his protective facade is stripped away, e.g., when a "stoic" is put in a position where he demonstrates that he actually cannot stand pain. The need to maintain dignity in the eyes of others is a strong one. When it is threatened, psychological defenses such as denial and rationalization are activated to maintain one's self-image.

The physician's approach should be *consistent,* combining gentleness and firmness. Such an attitude makes it possible to set limits to undesirable behavior (e.g., hyperactivity based on denial). Effective persuasion usually does not come about by forcing or commanding a patient to respond in certain ways. On the other hand, firm insistence may be quite effective as,

for example, in certain withdrawn and underactive patients.

Empathy, when it is used, should remain *transient* identification and should not be permitted to progress to overt and excessive empathy. Such an extended identification would become a source of undue distress for the physician and in no way help the patient. The other extreme, defensive withdrawal or protective detachment on the part of the physician, is undesirable because it fosters in the patient a sense of loneliness and rejection. (Incidentally, in contrast to the physician's general conduct with younger patients, physical touch can be used to enhance and promote the rapport between physician and aged patients.)

Maintaining a *realistic* approach to *palliation* in an ongoing doctor-patient relationship involves the recognition that the patient's many complaints offer the physician fertile ground for practicing his art. Whenever fresh complaints arise, the patient should be re-examined and offered some form of further treatment. For many elderly patients, the palliative supportive treatment which the physician can offer is their only remaining hope and anchorage point. Many elderly patients with chronic disease or disability live from one doctor's visit to the next. The clinician who can instill in his patient the conviction that he "knows how to take care of me" bolsters morale by approaching each new complication neither with excessive optimism nor undue pessimism, but rather with a realistic constructive attitude based on the knowledge of both physiologic and psychologic etiologic factors. His evaluation of the patient's difficult situation remains both compassionate and scientific and his palliative approach is guided by the knowledge that progressive physiologic disturbances lead to progressively disordered behavior on all levels of function, including the psychological.

The Comprehensive Approach

Psychosomatic Aspects of Therapy

In most, if not all, illnesses, psychological factors enter sooner or later—either early as a contributing etiologic factor or relatively late as a complicating factor. Geriatric illnesses represent psychosomatic problems *par excellence*. The psychosomatic approach to geriatric disorders involves evaluation of the psychological effects from disease and disability (*somatopsychology*) and exploration of the possible contribution by psychogenic factors to the etiology of somatic conditions (*psychophysiology*). The psychosomatic approach is of practical significance because it provides a framework for specific rehabilitative techniques which take into account psychodynamic and psychotherapeutic factors. Clinical skills in this area require thorough acquaintance with geriatric pathophysiology and an understanding of psychodynamic processes supplemented by and integrated with clinical experience. Such skills are a necessary prerequisite for effectively implementing the principles of comprehensive treatment.

The classical psychophysiologic reactions include duodenal ulcer, bronchial asthma, etc., but more common are psychosomatic sequences in which latent organic illness is precipitated or existing organic illness is aggravated by psychogenic factors. Anxiety, for example, may lead to hyperventilation which in turn may upset a tenuous cardiopulmonary balance in cardiac patients.

Psychological reactions that result from alterations or losses of structure and function of organs (somatopsychological sequences) depend on the personal meaning of the illness to the patient, the nature of the physical illness, changes in the body image, and on the vicissitudes of the illness situation (the doctor-patient relationship and the changes in the patient's social role). The existence of these secondary psychological reactions is not only responsible for mental suffering per se but may also lead to further aggravation of the primary physical illness. The vicious circle which develops in such a case leads to a complex clinical picture in which the intertwined physical and psychological factors are difficult to disentangle.

Not infrequently, a patient may complain of symptoms that suggest physical illness, but careful examination reveals no organic pathology. These patients are "psychosomatic" in the sense that their physiological distress is a manifestation of a psychological disorder (e.g., conversion reactions and hypochondriasis). The management of these patients is difficult and requires a careful balancing of psychotherapeutic techniques and regular medical attention.

Rehabilitation

Chronic disability usually is accompanied by a number of psychological reactions. These reactions become a problem when they represent maladaptive responses; that is, when the psychological response creates more problems than it solves.

Some of these maladaptive psychological reactions

to chronic disease and disability are: excessive regression resulting in an overall disability that is disproportionate to the physical illness; loss of self-esteem, resulting in depression; hostility, leading to alienation of relatives and medical personnel; denial of illness, leading to self-destructive behavior.

An essential part of rehabilitation is a therapeutic effort aimed at removing or alleviating such maladaptive behavioral responses. This may be a difficult procedure which requires time, tact and perspicacity. For example, a cardiac patient may deny the seriousness of his condition, a denial which is based on a wish to appear strong. Since the denial involves dietary indiscretions and neglect of medical advice, it is obvious that real progress would depend on the removal of this pathological defense. An understanding of the patient's psychodynamics (i.e., the wish to be strong) might provide a possible solution. In this case the physician can convey to the patient that it would take a great deal of strength and courage to adhere to such a diet and medical regime.

The objective of optimal rehabilitation is the establishment of a balance between the patient's assets and liabilities, both physical and psychological. If, for example, in the above mentioned cardiac patient, the underlying wish to be strong is related to conflicts about oral dependency, then the deprivation inhernt in the dietary restriction may precipitate a depression. The latter can be as disabling, or even life-threatening, as the cardiac condition. In such a case, it would be wise to follow an intermediate path.

The value of exercise of psychological and physical functions in maintaining their efficiency, points to the need for patients to be out of bed and carry on meaningful activities compatible with their physical status. Motivation to activity must include a goal that seems worth the effort to achieve. A patient may learn to walk following a stroke, but unless he has a reason for walking, he may soon abandon the attempt.

The milieu of the average hospital, and especially of the chronic illness or convalescent facility, frequently offers little incentive to activity; instead, it tends to foster regression and hasten deterioration. Some of the benefits of home care programs are that the patient sometimes receives better psychologic care from family members than from the professional staff of institutions, and especially that the patient is in a familiar environment where he feels "at home."

The physician should urge that activity be more than passive participation in time filling work. Therapeutic activity has purpose: the more completely it absorbs the patient's energies, the more beneficial it will be. When activities bring about interactions among patients, isolation is reduced and satisfying groups are formed. The loneliness and emotional starvation of geriatric patients make them appreciate physical contact with others: the touch of human hands. This may add a valuable dimension to the important role of the physical therapist.

Remaining potentials and abilities in the patient should be evaluated and emphasized. One should not discuss disabilities and restrictions without also emphasizing what the patient can still do. He should be encouraged to care for himself as much as he is able, but self-care and independence have appeal for him only to the extent that there is something to live for. Rehabilitation depends on the amount of increased independence that the patient is emotionally ready to accept.

Feelings of helplessness can be managed by fostering in the patient a subjective sense of control. This can be accomplished by anticipating some of the patient's needs and making provisions to satisfy them before they arise. Mobilization can be encouraged and diversions can be provided which are consistent with the patient's remaining potentials. Finally, the physician can identify himself to the patient as one "who knows how to take care of me," and by encouraging in the patient, a firm conviction that the physician is siding with him as a dependable ally.

A few comments may be in order here concerning the issue of "activity versus inactivity." These concepts are relevant with regard to the controversy about "disengagement," (Cumming and Henry, 1961), which apparently is interpreted by many in terms of passivity —and, therefor, "bad."

True passivity in the sense of non-functioning of an organ system or organism is undesirable because it leads to disuse atrophy of those functions and structures not actively used.

Optimal activity is in keeping with both the functional potential and structural limitations of the organ or organism. Such activity may or may not be externally visible. For example, activity of the cerebral cortex, i.e., thinking, though "invisible," is by no means passive. A thinking individual is active, the activity being cerebral. Only when this cerebral activity occurs at the expense of other functions, such as muscular activity, can we speak of passivity. Apparently, it is kinetic muscular activity (locomotion,

speech, etc.), visible to the external observer, which usually is referred to as activity.

Another consideration is that some functions and activities require relatively little energy and, therefore, are passive in that sense. Entertainment, for example, may be either active (e.g., sports) or passive (watching a movie). But even passive entertainment requires the energy expenditure of "taking in" by looking or hearing. Sensory input in general, far from being passive, involves a certain process of selection and active "taking in."

In addition, of course, there are highly specific mental processes associated with a given type of activity. The onlooker of a play, for example, may identify with one of the characters in the play, a form of mental activity on the level of imagination. Such identification in fantasy may lead to highly personal types of satisfaction or to enhanced self-esteem. A spectrum of optimal activity involves most of the individual's capacities and functions, as in recreational pursuits, and leads to a sense of physiological and psychological well-being.

Essential in rehabilitation is *maintaining hope.* The need for good prospects is basic to intact ego functioning and to integrated, goal-oriented behavior. Hope is vital to the patient's will to live and to face the future constructively. When the patient has reason to feel that the future is bleak and has little to offer, one may attempt to draw his attention away from the future onto what is more immediately at hand. The same applies to those persons who dwell unduly on a past which contained few, if any, satisfactions; a sense of despair may be prevented by focusing more on whatever satisfactory experiences are available in the present. On the other hand, when the past contains many "shares of happiness," one may encourage the older person to turn to these securities of the past. Reminiscing constructively about previous gratifications may lead to a sense of gratitude in the present.

Geriatric Psychopharmacology

With increasing age of the elderly individual, drug activity changes. This is related to a number of factors such as changed absorption of the drug, alterations in its metabolism and excretion. In addition to these specific age-related factors, there are some general factors responsible for different reactions to drugs among different individuals at any age. Two important factors pertain to the law of initial value and the placebo-effect, respectively.

According to the *law of initial value* (Wilder, 1958), the response of an organism to a stimulus depends, among other things, on the pre-stimulus(baseline) condition of the organism. Thus, a stimulating drug is likely to be less effective if the organism already is in a state of excitation; and a sedative agent is less effective in the presence of a state of inhibition or depression. In fact, in both of these instances, there may be a paradoxical reaction to the drug: the excited patient may become less excited following administration of a stimulant; and the inhibited patient may become restless from a sedative. An example of the first situation perhaps can be seen in the case of children with hyperactive behavior disorders who quiet down when taking dexedrine. An example of the latter situation is seen in patients who are inactive, take frequent daytime naps and then cannot sleep at night. A sedative at nighttime is likely to have no effect or, paradoxically, may result in restlessness. The proper approach here is to promote activities during the daytime so that the patient is fatigued in the evening.

Personality characteristics such as extroversion, aggressiveness, introversion, passivity, emotionality, obsessiveness and being oriented toward action, undoubtedly also contribute to inter-individual differences in response to drugs.

The *placebo-effect* is probably an ever-present companion of the specific pharmacodynamic effects of a drug or compound. The placebo-effect refers to any reaction not due to specific pharmacodynamic effects but derived from the subjective meaning that the drug has to the patient. The doctor-patient relationship is one of the most important factors determining which meaning and value the patient unconsciously assigns to the drug. Therapies and drugs appear to be more effective when the physician himself is convinced of their usefulness.

Depending on these personal and interpersonal factors, the placebo-effect will be either favorable or unfavorable. In the latter case, the placebo-effect tends to be described as a "side-effect" of the drug. In some instances the placebo-effect outweighs and overshadows the pharmacodynamic effects of a drug. "Toxic" reactions from a placebo have been reported. Of course, many side effects are not due to unfavorable placebo-effects but to specific pharmacodynamic factors.

In view of these complexities and inter-individual differences in reactions, the physician would do well to acquaint himself thoroughly with the clinical application of a limited number of drugs. In this way he will

be better able to evaluate the patient's responses and to recognize and treat any side effects.

In planning the treatment for a patient, it is important to be as specific as is possible under the circumstances. This means that the physician should have formulated in his mind some basic notions concerning the pathogenesis of the disturbed behavior; in other words, a formulation of the reasons back of the development of the psychological disturbance that is to be treated. Of course, this may not always be possible, but this does not detract from the general value of the principle. Only by following it consistently and as much as possible can one avoid two dangers in pharmacological treatment; overmedication and the "shot gun" approach.

Overmedication is undesirable because it clouds the clinical picture. It becomes impossible to distinguish among the effect of the drug, the side effects, the placebo-effect and the effects of the patient's initial symptoms. Since aged patients frequently have several chronic conditions simultaneously, it is with them that overmedication is especially likely to occur.

The "shot gun" approach refers to the practice of indiscriminately blanketing the target symptoms with a barrage of drugs, in the hope that at least one of them will be effective.

Another risk is that of undertreatment. Some psychopharmacological agents begin to exert their maximum therapeutic effect only after a period of some weeks following the initial doses. The physician should acquaint himself with the characteristics of the drugs he is using. In the case of schizophrenia, for example, it may take several weeks of phenothiazine administration before the therapeutic effectiveness can be evaluated. To stop treatment before that time or to fail to increase the dosage to optimal levels may be worse than no treatment at all.

Pharmacologic treatment, as well as other forms of organic treatment in psychiatry act, by and large, symptomatically. At the current state of knowledge, geriatric psychopharmacology is primarily aimed at the treatment of disturbed behavior rather than based on considerations of etiology. Similar types of psychological disturbances may be the result of different psychiatric syndromes. Agitation, for example, may occur both in schizophrenia and organic brain syndrome; apathetic withdrawal in depression, schizophrenia and senility; etc.

Psychotherapy

Psychotherapy is either supportive or insight oriented. The latter is specifically the scope of the psychiatrist. The former, however, is not only carried out by psychiatrists but also by non-psychiatric physicians—probably more often than they realize. Most psychotherapy with aged patients is supportive in nature.

Supportive Psychotherapy

In supportive psychotherapy the goal is not insight, but support of existing coping mechanisms in the face of current hardships. Adaptive defenses are strengthened and/or replace maladaptive ones. For example, fantasies that are autistic or unduly regressive may be gently discouraged and "kept in the back of the patient's mind" by encouraging defenses such as suppression or by focusing on the symptoms of an existing physical condition.

Guidance and counseling are forms of supportive therapy and specifically aim at improving ego function. Insight-psychotherapy, although concerned with this too, primarily seeks to unravel intrapsychic malformations that cause problems in living. Guidance and counseling refer to treatment, either individual or group, which aims at specific *environmental* problems, and at less extensive goals than in the case of insight-psychotherapy.

In *counseling*, the physician who may or may not be a trained psychotherapist, helps the patient in arriving at, or in accepting from him, a solution of the current difficulty. By suggesting a course of action and supporting the patient in following that course, an attempt is made to resolve dilemmas and to alleviate problems. The content of the interviews, usually few in number, focuses on actual realities in the interpersonal or situational difficulty. Likewise, explanations are reality-oriented. Only the events related to the perceived problem and their significance are evaluated and discussed. Deeper level problems may be recognized by the counselor but they are not pursued. After the main problem has been identified and correlated with associated secondary difficulties, a solution may be reached by way of collaboration between the two participants. Or, advice and "prescription" may be given concerning various alternatives of behavioral patterns and problem solving.

In *guidance*, unlike counseling, the attitudes and feelings involved in the patient's problems are brought to light so that they can be considered by him. As in counseling, the unconscious motivation which forms

the basis for, or contributes to, the problems is not touched.

Guidance is indicated when the emotional significance of an individual's problem extends beyond the scope of the ego's problem-solving capacity. Counseling is based on the assumption that the patient can deal with the problem once a course of action has been outlined, and that there is minimal interference due to anxiety or other emotions in implementing that course of action. In guidance, however, the emotional factors involved (e.g., guilt or hostility) are of such magnitude or quality that the ego cannot function effectively until they are brought to light and their role understood.

The encouragement and support of the physician, who can exert leverage as an authority or parent substitute, frees the patient's resources otherwise restricted by intrapsychic obstacles (anxiety, guilt, etc.) as well as by external environmental impediments. Clarification of the problem usually cannot be achieved without elimination of guilt, fear or anger which may be involved. These are not traced to their unconscious sources, however, but improvement is accomplished by the therapist's support (empathy, acceptance and permissiveness).

Counseling and guidance may be useful in problems of retirement, sexual and marital problems and in the contacts with relatives of aged patients.

Insight-Oriented Psychotherapy

A distinct difference between supportive and insight-oriented psychotherapy is the use of free association in the latter. The primary goal of insight-oriented therapy is not the solution of practical problems or external conflict but to alter the personality structure so that it may function more effectively. This involves an *intrapsychic* change: a correction of the balance between the intrapsychic systems (id, ego and superego).

In insight-therapy, memories hidden in the unconscious are unearthed. This mobilizes, at the same time, the feelings associated with these memories. Thus, their role and significance in current realities can be explored. The hallmark of insight-therapy is analysis of the transference. From the above, it is clear that insight-oriented psychotherapy will be only rarely employed with aged patients. Supportive therapy such as counseling and guidance is usually indicated.

One indication for insight therapy refers to the quest for meaning encountered in some aged patients. If, indeed, one of the tasks and goals of senescence is a sense of "integrity" (Erikson, 1959), the therapist may be confronted with the task of assisting the patient in his efforts at ascertaining who he is—after all —and what his life added up to.

Group Therapy

Usually, psychotherapy with the aged is best carried out in a group context. Group experiences enhance in the patient a sense of sharing and belonging, an appreciation for the value of external sources of satisfaction, and the effectiveness of reality testing. Group therapy, by and large, is supportive in nature. The group provides an opportunity for ventilation of emotions and for discussion of relevant issues (retirement, societal attitudes, religion, "the good old days," complaints about the institution, etc.). Patient groups may also be engaged in activities such as occupational or art therapy and discussions of current political and international events.

Recreational therapy, carried out in a group format, may employ a form of psychodrama in which aged patients are assigned certain roles to play, which are expected to be therapeutic inasmuch as these roles entail the ventilation and catharsis of specific emotions and ideas. In the setting of role-playing, such a ventilation can be accomplished by the patient without any feelings of guilt on his part.

An essential aspect of group therapy has been described in terms of resocialization. The therapeutic interventions of resocialization aim to prevent or reverse the social isolation which, particularly in senescence, may lead to serious psychological changes.

Group therapy can be carried out in outpatient facilities, e.g., day care centers, psychiatric clinics and institutions (geriatric wards, homes for the aged). It can be conducted by a psychiatrist or by non-psychiatric physicians, as well as by clinical psychologists, social workers, nurses and other health personnel provided they have had some training in this area and work under supervision of a competent physician.

CLINICAL MANAGEMENT OF PSYCHIATRIC DISTURBANCES

A patient's defenses should never be exposed, interfered with or removed without wondering what he is defending against and, if possible, ascertaining what the underlying concern is. To remove defenses can be compared with taking away the crutches from a para-

lyzed patient. When a particular defense is removed, another one is likely to take its place.

For example, a 64-year-old schizophrenic woman had been unable to walk for years. Repeated neurological examinations showed no abnormalities. In spite of marked disuse atrophy of the legs and strong resistance on the patient's part, she was forced into walking. Soon after that she began to display outbursts of severe rage, as soon as anybody tried to come close to her. The inability to walk (a conversion symptom in this schizophrenic patient) and the display of rage to others both served to maintain her isolation and distance from others. When one behavior pattern was "removed", another emerged to take its place. In this patient the rage attacks proved to be less maladaptive than the inability to walk because, after all, she did react to and interact with other people. After about 3 months, the rage attacks subsided while, at the same time, the patient made remarkable progress in walking.

Thus, it may be useful to try to remove maladaptive defenses and to encourage more adaptive ones. Generally, adaptive defenses presuppose some amount of cognitive awareness about the problem and its significance, a willingness to seek help and realistic adjustment to the inevitable vicissitudes of life. Maladaptive defenses increase a person's misery, deplete his resources, often in the manner of a vicious circle.

Special emphasis may be placed on specific psychotherapeutic techniques such as encouraging the patient to suppress certain regressive fantasies; to abandon introspection in favor of orientation toward present realities; to divert anxiety concerning deepseated serious psychological problems (e.g., latent homosexual conflicts) into other directions (e.g., physical symptoms), or to divert a paranoid recluse into the sick role since the latter provides an opportunity for clearly structured interpersonal contacts.

Management of Specific Disturbances

The illness situation (the vicissitudes resulting from the sick role, hospitalization, etc.) may give rise to emotional reactions such as grief, anger and guilt. For the purpose of therapeutic communication, it is necessary to view disturbed behavior as a malfunction of the total organism, just as one would regard physical signs as a manifestation of malfunction of a particular organ. It is then easier to maintain an attitude of detached concern, to preserve one's own peace of mind and to remain both objective and helpful. This is especially useful when the patient's behavior is irritating, for example, because of excessive regression or hostility.

Many of these emotional reactions can be relieved by providing an opportunity for self-expression and ventilation. The sharing of distressing experiences also counteracts the sense of isolation. The physician will frequently discover that he actually can be helpful to the patient by simply listening to him. The patient's knowledge of having an interested listener decreases his loneliness, builds up his self-esteem and sustains his hope and confidence.

Self-expression and the ventilation of emotions can be useful in aged patients when it is encouraged with discretion and with specific therapeutic goals in mind. Certain emotions lying just below the surface, such as grief about loss of an organ, anger at the physician or other medical personnel for lack of improvement, guilt about dependency imposed by illness—all of these can be alleviated by discharging them. The expression of such emotions can be regarded as therapeutic in the same sense that removal of organic pathology can be therapeutic.

In many aged patients, especially those with long-standing emotional conflict, however, the self is in a state of crisis and they may feel threatened by imprudent probing for deeper buried emotions, such as fear of death. When no direct reassurance is possible concerning deepseated fears or conflicts, it is better to avoid pressing the patient to indulge in soul-searching, although, of course, voluntary confidences should not be shunned when they are offered spontaneously.

Anxiety and Tension

To allay anxiety, all the therapeutic principles underlying optimal doctor-patient communication must be observed. The promotion of optimal regression and dependency in the patient is therapeutically useful because it takes the patient's attention away from many anxiety-provoking concerns in an uncertain future. Optimal regression, possible only in a firmly established doctor-patient relationship, is an effective antidote against anxiety. For some aged patients, the contacts with the physician are a veritable lifeline. Thus, certain maladaptive defenses may be prevented from developing because the motive of anxiety is absent.

An attempt should be made to prevent, eliminate or treat whatever anxiety-provoking factors are present. In the aged these factors often pertain to fearful anticipation of loss of external supplies. An exploration of

the patient's life situation may reveal the existence of anxiety-provoking factors such as role uncertainty and intrafamilial strife, borderline economic resources, relentless progress of physical disability, drastic changes in the body image, etc. In many of these instances, specific supportive measures (reassurance, clarification, agency-referral, etc.) will be effective.

The wish for reassurance reflects the universal need for emotional security and this wish is especially prominent in aged patients. The effectiveness of reassurance depends on whether it is true or false reassurance (Verwoerdt, 1966).

False reassurance is not effective because it is prompted by the wrong motive, e.g., the need to protect oneself. False reassurance has a reactive quality; it is an automatic reflex-like response, rather than consciously thought through. It would be false reassurance, for example, to say to an anxious person with cancer or heart disease: "It won't be bad." Patients usually recognize the false quality of such reassurances.

True reassurance, on the other hand, acknowledges the personal meaning of the illness to the patient, the probability that emotional distress will arise and his need for help in coping with it. True reassurance may also be conveyed to a patient by emotional security and lack of alarm in the physician himself. For example, discussing an emotionally charged topic in a tone that combines calm and lack of alarm can have a disalarming and "detoxifying" effect on the inner turmoil of a patient.

Anti-anxiety drugs (the "minor" tranquillizers) include meprobamate (Miltown, Equanil), hydroxyzine (Vistaril), chlordiazepoxide (Librium), and others. They can be used for the symptomatic treatment of anxiety, agitation, insomnia and tension. Not infrequently, however, these symptoms can also be treated by increasing the patient's level of activity. The physiological concomitants of anxiety and tension often may be alleviated by increased expenditure of energy, e.g., walking, physical therapy. Some cases of insomnia are related to lack of sufficient fatigue in the evening. To give a tranquillizer or sedative in such an instance may only make matters worse.

Management of pain should involve a consideration of the intimate connections between anxiety, tension and pain. Organic pain conforms in a characteristic manner to what one would expect on the basis of anatomic lesions. Pain which is more or less psychogenic, however, is related to anxious fantasies about the illness, to mental conceptions of progression of pathology, and to perceived body image disturbances. The regressed or hypochondriacal patient may be so preoccupied with bodily overconcern, that almost any sensation or distress can be perceived as painful.

Grief

Generally, it is important to encourage expression of existing grief and sadness. This does not only afford the patient a sense of relief that is both physiologic and psychologic, but it helps him feel closer to the physician who was present to share the experience. Management of grief involves promoting a realistic awareness on the part of the patient of the loss which he suffered and encouraging open expression of his bereavement. It helps to induce a patient who has been bottling up his grief to give in to his feelings and cry. Some patients need the reassurance that grief and sadness are natural and that mourning represents a period which must be entered, traversed and completed.

At the same time, however, the patient can be advised that, since thoughts concerning the lost object will be frequently on his mind, it is wise to seek new diversions, activities and contacts to draw him away from excessive preoccupation with the loss.

Thus, the physician attempts to guide the patient down an intermediate path which, on the one hand, avoids premature closure (e.g., suppression of grief) and, on the other, steers away from excessive melancholic involvement by venturing into new activities and contacts which will eventually engage the psychic energy previously invested in the lost object (Verwoerdt, 1966).

Feelings of guilt can be relieved by encouraging the patient to talk about his real or imagined transgressions to which he sometimes "magically" ascribes the cause of his present plight. The physician can then mention that such thoughts and feelings are understandable and part of our being human. He can indicate that his own experiences have made him closely familiar with such expressions of human nature. At the same time, he can suggest that it is always difficult to reach definite conclusions about how and why an illness had its beginning.

Depression

Many depressive conditions eventually improve without specific antidepressive therapy. The latter, however, may hasten the process of recovery.

In depressions that are mild or moderate in degree, reactive or neurotic, antidepressant drugs can be tried first. It is generally accepted that antidepressant drugs such as Imipramine (Tofranil) and Nortriptyline (Aventyl) are valuable although the degree of effectiveness and the pharmacodynamic specificity remains to be clarified.

Psychotic depressions are best treated with ECT. Elderly patients generally withstand this procedure well, provided adequate use of muscle relaxants is made. Contraindications to the use of ECT include a history of recent myocardiac infarct, severe cardiac or respiratory illnesses and organic brain syndrome of moderate to severe degree. ECT can be given in conjunction with antidepressant and antipsychotic drugs. It is preferable, however, to utilize only one specific treatment method at the time, lest one lose sight of what is going on. If at all possible, a therapeutic "shotgun" approach should be avoided.

Hostility

Hostility, anger and aggressiveness are the result of frustration and therefore occur under a great variety of conditions.

In some cases, the hostility is defensive and covers a deeper layer of anxiety or depression. Specific treatment of the underlying factors is indicated; if successful, hostility will decrease.

In cases where hostility results from delusional thought content, phenothiazines are indicated.

A patient may have outbursts of rage in order to attract attention; in such a case, the patient may quiet down when people in the environment begin to take out regular time to be with the patient and establish contact with him. Drugs may cause improvement, not in the least by way of the placebo effect.

In organic brain syndrome, aggression and hostility may result from an interaction of perceptual distortions, delusional thoughts, severe regression and loss of emotional control. Thorazine and Mellaril can be used in conjunction with the other measures suggested for the treatment for organic brain syndrome.

Generally, anger in the patient requires the cool, objective recognition of hostility as a symptom of an underlying disorder. The ability to avoid reacting to a patient's hostility on the personal level and to observe it with proper detachment serves as an important clinical tool. Once the physician has ascertained what the patient's defensive hostility is directed against, he can attune his responses, not to the presenting facade of hostility, but to the underlying problem covered by the facade. In this way one can sidestep the hostility rather than moving against the patient in counterhostility or moving away from him by avoidance.

Apathy

Apathy (literally "absence of emotion") refers to a condition of emotional exhaustion or depletion (as in severe chronic physical illness and depression) or a state of severe emotional withdrawal and uninvolvement (in schizophrenia and senility).

Apathy in the sense of emotional exhaustion should not be treated by an approach of stimulation but by intensive supportive treatment. The principle involved is to nurture, build up and restore an organism whose inner resources and adaptive capacity are critically diminished. This involves:

Adequate treatment of any physiologic disturbances.

Insuring adequate sleep, rest, food intake and promotion of anabolic-metabolic processes in general.

Elimination of emotional insecurity by establishing a firm rapport in the doctor-patient relationship and permitting the patient to become dependent on the parental figure of the physician.

Upon return of emotional responsiveness and interest in the external world, the physician should not withdraw his support, but maintain contact with the patient allowing him to set his own tempo of emotional recovery. To withdraw from the patient when he improves is to encourage relapse in apathy.

Most important during this critical phase is exploring with the patient toward which persons and activities his reawakened interests can be directed.

Apathy, withdrawal and seclusiveness resulting from such conditions as schizophrenia or organic brain syndrome frequently require an approach of appropriate stimulation. Many such patients are apathetic not because of exhaustion but because they prefer the gratifications of their inner fantasy world over those provided by the real word. The treatment involves:

Drugs (phenothiazines; antidepressants).

Remotivation, resocialization and other group experiences toward which the patient may be better motivated following drug treatment.

Auxiliary therapies: occupational, recreational, industrial and physical therapy.

The "buddy system" approach: assigning one of the nursing personnel, or another patient (e.g., a suitable younger psychiatric patient), or any volunteer to spend regular time with the patient.

Expansive Behavior

Expansive behavior, e.g., grandiosity and elation, may occur in manic states, paranoid schizophrenia or some cases of organic brain syndrome, especially presbyophrenia. Irascibility, garrulousness and suspiciousness frequently are associated with the grandiose, euphoric or expansive mood.

Manic grandiosity requires treatment especially when the patient's behavior is self-destructive, a nuisance (extreme hyperactivity), or when his overconfidence and lack of judgment prompt him to make unwise decisions or to engage in inappropriate actions. Thorazine usually is effective in reducing the patient's manic behavior. ECT may be considered as an alternative.

Paranoid grandiosity preferably is treated and controlled with one of the phenothiazine drugs. ECT is rarely indicated. The same holds true for grandiose and expansive behavior occurring in the presence of chronic brain syndrome. Of course, manic behavior in acute brain syndrome, such as caused by alcoholism, requires that primary attention be given to eliminating the cause of the organic brain syndrome.

Confusion and Disorientation

The presence of confusion and disorientation, especially when sudden and acute, requires first of all a search for physical factors which may be responsible (cardiac, respiratory and metabolic disorders, dehydration, nutritional deficiencies, etc.).

Effective treatment of such etiological factors is of paramount importance. Of course, other therapeutic measures may be properly used as well. Some of these include:

Prevention and elimination of unnecessary or inappropriate medication (e.g., barbiturates, bromides or overmedication).

Maintenance of spatiotemporal constancy, such as keeping the external environment the same, reducing the frequency of strangers and new personnel, avoiding transfers and alterations in routine.

Frequent and regular explanations of procedures in simple terms; mentioning one's name and function at regular intervals.

Alleviating nocturnal confusion by preventing the relative isolation and sensory deprivation which may occur during the night.

When confusion and disorientation are the result of a chronic brain syndrome, the long-term regimen includes, in addition to the above:

Reducing psychological stresses such as agitation, depressive withdrawal, etc.

Promoting contact with reality by way of visitors, familiar newspapers, calendars and clocks, etc.

Structuring a time perspective: within each day, meaningful events should be arranged and the days of the week should become distinguishable from each other by virtue of just noticeable day-to-day differences in the routine. Otherwise the hours and days and all time tend to become undifferentiated and meaningless. In such a case, it would be useless to try to re-orient the patient by way of clocks and calendars: these would only indicate empty and meaningless time.

Drug Therapy

A combination of metrazol (a CNS stimulant) and nicotinic acid (a vasodilator) has been reported to be effective in cases of chronic confusion. It is wise, however, to use first the above described methods and to wait until the acute confusional state has subsided and the patient has settled down to his "baseline level" of confusion. Generally, it would not appear to be prudent to administer CNS stimulants when the patient's confusion is acute, reactive or when the patient is receiving other psychotropic drugs. Likewise, monosodium l-glutamate can be given a trial. This aminoacid apparently has beneficial effects on cerebral metabolism.

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SECTION A/DISEASES AND DISORDERS MOST RELEVANT TO SINGLE ORGAN SYSTEMS

Part IV/The Cardiovascular System

SPECIAL FEATURES OF HEART DISEASE IN THE ELDERLY PATIENTS

By

Raymond Harris, M.D.

INTRODUCTION

Heart disease in the aged is seldom, if ever, pure and usually consists of changes due to aging and one or more of the conventional types of heart disease. This discussion provides useful information about these changes and their effects on the development, manifestations and treatment of heart disease in the aged person. Its primary objectives are: first, to identify that subject material relevant to the aging process and heart disease which may facilitate the diagnosis and management of the aged heart patient; second, to stimulate greater interest and curiosity about heart disease in the elderly; and third, to reduce the morbidity, mortality and cost of heart disease in the aged population. Although the natural processes of aging cannot be counteracted, longevity may be extended and disability reduced by better total medical care of the aged cardiac, provided the patient, the aging process and the special features of heart disease in elderly patients are understood.

This focus on heart disease in the elderly is important because heart disease is the most common cause of death in the population aged 65 and over. The death rate from heart disease in this age group is twice as high as stroke, the next most common cause of death. Together these two diseases account for a death rate of 9,319.8 per 100,000 persons, almost 10 times the rate of the next most common cause of death —cancer (993.4 per 100,000 persons). Furthermore, the social, psychological and economic toll of these diseases in terms of disability, disruption of family life and money constitutes an enormous drain on the resources of the patient, family and Nation.

This monograph consists of three sections:

1. *The Cardiac Parameters of Aging* summarizes the effects of aging on the cardiovascular system;
2. *Clinical Manifestation of Heart Diseases in the Aged* emphasizes the special clinical features of heart disease in the aged and alerts the physician to some differences in manifestations of heart disorders between old and young cardiac patients;
3. *Common Forms of Heart Disease in the Aged* discusses the more common forms of heart disease and their treatment in older patients.

These three sections present a comprehensive "bird's-eye" view of heart disease in the aged and demonstrate how the aged person, representing the survival of the fittest over disease, is prone to develop some form of heart disorder. Appreciation of these changes and application of the information in this monograph can improve the medical care of the aged cardiac patient and reduce the morbidity, mortality and cost of heart disease in this age group.

THE CARDIAC PARAMETERS OF AGING

Gross and Microscopic Structure of the Heart

This section presents the gross and histologic cardiovascular changes developing in many elderly patients without clinically evident heart disease. Through the years, these alterations may develop as a reaction to hemodynamic stress and to the aging process, the pathophysiology and biochemistry of which remain imperfectly understood.

The *heart size* in old persons without hypertension or clinical heart disease remains the same as in middle age or becomes smaller as a result of the reduced

physical demands and activity of old age. Even hearts once enlarged from valvular heart disease, hypertension or other stresses may shrink in old age under the influence of rest and reduced activity. Cardiac atrophy may be seen in the elderly patient with prolonged illness, confinement to bed or malnutrition (McKeown, 1965).

The *gross appearance* of the aging heart also changes with age (Cohn, 1942; McKeown, 1965). The color of the heart muscle becomes a deeper brown and the amount of subpericardial fat increases. Fat appears at the entry of the pulmonary veins, the superior vena cava posteriorly, the base of the aorta and extends from the left circumflex coronary artery upward over the left atrium to involve the region of the sino-atrial nodes and the intercaval band. By the fifth decade, fat from all these regions may become confluent. For some unknown reason the subpericardial fat increases less over the left ventricle than over the other chambers.

Endocardial changes result from the effects of the constant hemodynamic stress on the endocardium. Endocardial thickening and sclerosis show up as thickened whitish patches in the endocardium, the left atrium, the right atrium, the papillary muscles and apical endocardium of the left ventricle. This process usually spares the right ventricle which is under less pressure. Microscopically these areas of endocardial hypertrophy show a marked increase in collagenous tissue.

The *valves* are greatly subjected to hemodynamic stress and become more rigid and thickened due to sclerosis and fibrosis (McMillan and Lev, 1964; Sell and Scully, 1965). The mitral valve is most severely involved. Its inferior leaflet develops a focal nodularity. Slight thickening of the tricuspid valve and of the base of the pulmonic valves may also be noted. The aortic leaflets show increased thickness of the noduli and the lines of closure. In old age, there is marked thickening of the base of the aortic cusps with, in some instances, agglutination of the commissures and the production of Lamblian excrescences (Lev, 1957). These changes, due to aging, distort the mitral and aortic valves, render the valve closing less accurate and produce murmurs simulating acquired heart disease. The hemodynamic consequences of these changes are not too important clinically unless they are superimposed upon acquired valvular disease. In this event they may constitute the "straw that breaks the camel's back." Their added burden is just enough to topple the sick patient into congestive heart failure.

Histologic alterations in the aged heart include greater amounts of collagen in the valves and endocardium, increased lipochrome pigmentation at the poles of the nuclei of the myocardium fiber (Strehler, et al., 1959), apparent shrinkage and loss of muscle fibers, and focal hypertrophy of the individual fibers. The elastic fibers of the pericardium and the selective fibroelastic thickening increase in the region of the sino-atrial node. Focal thickening of the elastic and reticular nets and infiltration of fat about and in the node are observed. These changes are most marked in persons between 40–60 years of age and show little progression after 60 (Lev, 1954).

Calcification of the media and elastic proliferation of the musculoelastic arteries constitute basic aging phenomena, uninfluenced by sex or chronic diseases, except hypertension and syphilis. Calcification of the left coronary artery begins in the second decade and calcification of the aorta in the third (Lansing et al., 1948). The small muscular arteries, including the coronary arteries, show intimal thickening which narrows the lumen and reduces the blood supply to the various organs (Lober, 1953). Since these organs are undergoing involution, they require less oxygen and usually are not seriously embarrassed by these changes. These senescent histologic changes in the coronary arteries parallel the electrocardiographic changes with age (Simonson and Keys, 1952; 1956).

The aging aorta and the great muscular arteries show a definite trend toward an increased collagen-elastin ratio which causes the aorta and great muscular arteries to dilate, lengthen, enfold and become less elastic. The muscular arteries of the head, neck and extremities become more prominent and tortuous in the older person because of these changes and the loss of subcutaneous fat. The carotid artery may become kinked and simulate an aneurysm in the neck.

Physiologic Characteristics

Although the aging heart can function adequately in most old people as long as the coronary system is not damaged, certain physiologic alterations may occur with age (Harris, 1961–b).

1. The cardiac reserve diminishes and the heart reacts poorly to sudden stress.

2. The cardiac output drops about 1 percent per year below the normal value of 5 liters per minute found in younger persons. The reduction in cardiac output results from a decreased stroke volume due to

aging and a slower heart rate (Brandfonbrener, et al., 1955).

3. The estimated left ventricular work declines at rest (Landowne, et al., 1955).

4 .The maximum blood flow through the coronary artery tree at the age of 60 is about 35 percent lower than in youth (Dock, 1941; 1956).

5. The aged myocardium shows a delay in the recovery of contractility and irritability. Despite its slow rate of recovery it functions well when there is an adequate period of rest between beats, but reacts poorly to tachycardia. Simple tachycardias of 120 to 150 beats per minute, caused by paroxysmal tachycardia, fever, emotions or other conditions can precipitate heart failure in older people, even without a rise in blood pressure.

6. Normal vasomotor tone decreases while vagal influence increases.

7. Peripheral vascular resistance rises 1 percent per year, about the same as the decrease in cardiac output per year (Landowne et al., 1955; Shock, 1957).

8. The heart is less sensitive to the effect of atropine and more sensitive to carotid sinus stimulation.

9. The aged heart has a decreased ability to utilize oxygen.

10. An increased pulse wave velocity found in older normotensive people reflects the increased rigidity of the larger and medium arteries with age (Hallock, 1934; Wezler, 1935; Haynes et al., 1936; Wiggers, 1949).

The *cold pressor response* increases with age due to the gradual increase in the irritability of the vasoconstrictor medullary center produced by ischemia, minute arteriosclerotic lesions or deterioration of specific neurone groups within this area (Russek and Zohman, 1945). The rising vasopressor response in the aged has also been attributed to a gradual diminution in cerebral blood flow which leads to ischemia of its nerve centers controlling vascular tonicity.

The pulse rate varies from 44 to 108 beats per minute in old age. As a rule, the mean pulse frequency diminishes between the ages of 60 and 84, without any significant variation among the different ages or between men and women. The great variability and range of the pulse rate in old people explain the relative uselessness of pulse charts in assessing the onset of an acute infection (Howell, 1948).

The *blood pressure* in the aging organism depends upon:

1. The loss of elasticity in the walls of the larger arteries which tends to raise systolic and depress diastolic pressures;

2. The increased lability of vasopressor control which tends to raise both.

The first is a structural, vascular factor; the second, a functional, neurogenic factor. Their effects on systolic blood pressure are additive so that systolic blood pressure rises with advancing years. The diastolic pressure on the other hand, may rise or fall with age (Harris, 1954). The variability of the vascular and neurogenic factors with aging accounts for the controversy concerning normal blood pressures in elderly people which range in the literature from a very conservative upper limit of 120 mm. of mercury systolic and 80 mm. of mercury diastolic, regardless of age and sex, to more liberal values (Master et al., 1952; 1957; Master and Lasser, 1958). In extreme old age normal blood pressures generally range between 100–140 mm. Hg. systolic and 70–90 mm. Hg. diastolic.

Electrocardiogram

Accurate electrocardiographic diagnosis is imperative in old people since it is not always possible to use exercise or drugs to elucidate the cardiac problem. The electrocardiogram remains the best tool to: (1) detect myocardial disease, heart block, bundle branch block and silent myocardial infarction, (2) determine the significance of extrasystoles and other changes in heart rhythm; and (3) diagnose arrhythmias. Familiarity with the electrocardiographic changes due to aging improves the accuracy of the interpretation and the value of the tracing (Simonson, 1961).

In general, the normal electrocardiogram of the aged has no characteristics that distinguish it from that of younger persons. With aging, minor electrocardiographic changes may result from the cellular changes of age, neurogenic effects and minor fibrosis of the conduction system. The voltages of all waves may be diminished and there may be a slight prolongation of all intervals due to slowing of impulse conduction through the pacemaker, conduction system and the myocardium. With age, the mean QRS vector is directed further to the left and more posteriorly, and left axis deviation is generally found (Simonson and Keys, 1956). When right axis deviation is present, significant pulmonary emphysema, corpulmonale or other heart lesions increasing the strain and work of the right ventricle and atria should be investigated.

P waves may be smaller in the aged because of cellular changes and alterations in size and position of the atria (Olbrich and Woodford-Williams, 1953). In the limb leads, P waves may be so low as to be invisible, and nodal or other rhythms may be erroneously diagnosed when sinus rhythm is present. Usually, the P wave, atrial flutter and atrial fibrillatory waves are more visible in the chest leads V 1 and V 2, and review of these leads establishes the correct diagnosis. Occasionally, Lewis, esophageal or intracardiac leads may be necessary to detect the P waves and to diagnose the arrhythmia.

Other electrocardiographic changes in the aged may include a slightly longer QRS interval, and a lower T wave. The QT interval may increase with age but rarely exceeds the upper limit of normal for a younger person. The PR interval ordinarily does not become prolonged with advancing years. First degree heart block with a PR interval more than .20 seconds or 2° and 3° atrio-ventricular block indicate organic disease of the atrio-ventricular node or myocardial damage, except when caused by digitalis.

The amplitude of R and S waves, the sum of R_{v6} and S_{v1} (representing the left ventricular potential) and the sum of R_{v1} and S_{v6} (representing the right ventricular potential) do not ordinarily change in old age. When major variations occur in these amplitudes, extracardiac causes should first be excluded before they are attributed to heart disease. For example, decreased voltage of QRS and other waves in the aged may result from senile pulmonary emphysema and deformities of the thoracic wall. Increased voltages, in some precordial leads, may be caused by the decreased thickness of the chest wall and the closer proximity of the myocardium to the chest electrode. A helpful rule of thumb to remember is that discordant changes in voltage between QRS and T in the same precordial lead are more significant than concordant changes, i.e., a tall QRS and a low T wave or vice versa is more abnormal than a tall QRS and a tall T wave or a low QRS and low T wave. The transitional zone of QRS in the precordial leads varies with the rotation of the heart around its three axes. Inverted T waves in leads 1, 2 and the precordial leads in old age are abnormal and may indicate myocardial damage, ischemia or a small myocardial infarction involving the anterolateral wall of the myocardium.

Intraconduction abnormalities and advanced atrioventricular block indicate myocardial damage. Bundle branch block may be found without clinically evident heart disease. Parietal block, due to lesions distal to the branches of the left main bundle, occurs in 10 to 20 percent of clinically "normal" subjects over 60 years of age. This electrocardiographic pattern is characterized by a QRS of normal deviation and a mean QRS vector sufficiently beyond -30° to produce a principally negative QRS complex in leads 2 and 3. In these patients, postmortem examination reveals scattered patches of fibrosis throughout the left ventricle (Grant, 1958).

Radiography of the Chest

The radiologic configuration of the heart and lungs in old people varies with the degree of disease and deformity of the chest. Ordinarily the diaphragm of healthy, fit and active old people has the same shape and level as in normal middle-aged persons. The diaphragm is raised in obese elderly patients making the heart position transverse, and it is low in lean persons with pulmonary emphysema, making the heart position vertical. Chest disease or thoracic deformity may elevate the diaphragm asymmetrically.

There is little or no increase in the heart size in the very old, but the cardiothoracic ratio may increase because of the decreased width of the thorax (Simon, 1965). The heart size is normal when the transverse diameter of the heart shadow measures less than 50 percent of the transverse diameter of the chest wall. Shrinkage of the thoracic cage may at times cause the heart shadow to look enlarged when it is not, because of the increased cardiothoracic ratio. The average transverse diameter of most clinically normal hearts may appear smaller in the aged when senile heart becomes atrophic due to inactivity or when senile pulmonary emphysema widens the diameter of the rib cage. The pulsatile excursions of the heart do not decrease with age. Slight to moderate enlargement of the heart in elderly patients without other signs or symptoms of cardiac disease suggests coronary artery disease with myocardial fibrosis, burned out hypertension, or other heart trouble.

The aorta usually enfolds and dilates to a variable degree, independent of the level of blood pressure. Calcification of the aorta progresses with age more rapidly in women than in men. Marked widening of the aortic arch is rarely associated with significant calcification (Goldbloom et al., 1955).

The most constant visible change in the chest X-ray

of normal old people is the increased radiolucency of the ribs and vertebrae due to the loss of calcium from the bones with age. It is these changes that cause the radiograph to look like that of an old, rather than a young person (Simon, 1965).

CLINICAL MANIFESTATIONS OF HEART DISEASE

This section summarizes some special clinical features which characterize heart disease in the aged and are found less often in younger patients. These special features may result from the effects of the aging process itself, from the more widespread pathology seen in the older patient and, on some occasions, from the memory deficits sometimes encountered in the aged cardiac patient. A careful, comprehensive history and review of symptoms, course and previous drug therapy are most essential to separate noncardiac symptoms from heart complaints and it may be hard to diagnose heart disease accurately in the face of an avalanche of complaints often elicited from a garrulous aged patient.

The symptoms of heart disease in older people conveniently fall into three categories:

1. Conventional symptoms.
2. Unusual symptoms.
3. Iatrogenic (man-made) symptoms.

These groups of symptoms vary in meaning and significance, but the elderly patient without undue fatigue, pain, shortness of breath or swelling of his legs is unlikely to have serious heart disease.

Conventional Symptoms of Heart Disease

Acute or recurrent *chest pain* is a frequent complaint of elderly patients.

Shortness of breath is another common complaint of the aged. Breathlessness, fatigue and tiredness are terms often used interchangeably for shortness of breath by the aged. The patient should be carefully questioned to determine if he has ordinary dyspnea or some specialized form of labored breathing. Heart disease is the most likely culprit and should be investigated in the elderly patient, who has shortness of breath after exertion which formerly did not bother him, or who awakens suddenly with shortness of breath. Acute dyspnea rather than chest pain may be the presenting symptom of an acute myocardial infarction in the aged. Elderly people with poor cardiac reserve suffer such complaints even without heart enlargement or other signs of heart disease.

TABLE 1.—*Some Causes of Chest Pains in Old People*

Acute:

A. Angina pectoris, myocardial infarction
B. Pericarditis
C. Pulmonary embolism
D. Aortic aneurysm, dissecting
E. Pneumonia
F. Pleurisy
G. Congestion of liver due to heart failure

Recurrent:

A. Arthritis of spine
B. Spondylosis
C. Kyphoscoliosis of spine
D. Herniated disc
E. Fibromyositis
F. Tietze syndrome
G. Herpetic neuralgia (shingles)
H. Hiatus hernia
I. Esophagitis
J. Peptic ulcer
K. Cholelithiasis, cholecystitis
L. Tumor of lung, spine or rib

Cheyne-Stokes respiration also causes shortness of breath in the aged. It is a sign of reduced blood flow to the medullary breathing center, usually due to cerebral arteriosclerosis and aggravated by heart failure. Cheyne-Stokes respiration is 50 times more frequent in patients after 65 than in middle-aged patients below the age of 50. It is also a major cause of insomnia in the aged.

Cough and wheezing are important complaints of elderly patients with heart disease. These symptoms may indicate early left heart failure.

Cerebral symptoms, including vertigo, syncope, acute mental confusion and unexpected mental changes may be due to heart disease, water and electrolyte imbalance, or digitalis toxicity. Such symptoms or Cheyne-Stokes breathing due to cerebral anoxia and decreased cerebral blood flow may be the presenting complaints of the aged patient. Digitalis delirium is found more frequently in the elderly than in younger patients receiving digitalis.

Hemoptysis, a frequent symptom in the older patient, may indicate congestive heart failure. Pulmonary emboli should be suspected and treated when heart disease or other causes cannot be clearly identified as the cause of hemoptysis. Pulmonary emboli have a high incidence in the elderly.

Edema of both legs may signal right heart failure. The cardiac origin is easily established when an enlarged heart and tender hepatomegaly accompany the bilateral leg edema.

Unusual Symptoms of Heart Disease

The following symptoms may be less conventional complaints of elderly patients with heart failure or ischemic heart disease.

A. Acute abdominal pain from enlarged liver and congestion.
B. Anorexia
C. Insomnia, often due to Cheyne-Stokes respiration
D. Fatigability
E. Vomiting
F. Nocturia and urinary frequency.

TABLE 2.—*Man-made (Iatrogenic) Symptoms Commonly Seen in Older People*

Digitalis Intoxication
- A. Nausea and vomiting
- B. Yellow vision
- C. Mental confusion
- D. Weakness
- E. Apathy
- F. Diarrhea
- G. Arrhythmias
- H. Tachycardia

Diuretic Toxicity
- A. Fatigue
- B. Weakness
- C. Increasing mental confusion due to rising blood urea nitrogen
- D. Dryness and dehydration

Fluid and Electrolyte Disturbance Following Dietary Restriction and Overdiuresis
- A. Any of the preceding symptoms

Psychiatric Symptoms
- A. Anxiety
- B. Depression

Elderly heart patients may be extremely sensitive to digitalis and easily develop digitalis toxicity (Sodeman, 1965; Dall, 1965). Overtreatment with diuretics and excessive dietary restriction of fluids and electrolytes can also produce these symptoms.

Psychiatric symptoms may be induced or aggravated in the aged with heart disease by excessive fluid restriction or medication, resulting in an acute psychiatric episode.

The Physical Examination

The general health and vitality of an aged patient can be observed at the first meeting.

Inspection should note and assess the changes in the skin, the vascular pulsations and the degree and amount of tortuosity of blood vessels in the head, neck and extremities. In these areas decreased subcutaneous fat and the vascular changes due to aging and disease accentuate vascular patterns and tortuosity.

The examiner confirms the physical findings seen on inspection and checks peripheral and abdominal arteries for information about the arterial wall, pulse and heart rhythm. Absent pulsations indicate arterial obstruction in or proximal to the site of palpation.

Special attention to the palpation of arteries in the neck, abdomen and popliteal areas may detect occult vascular aneurysms not readily visible on inspection. The incidence of these vascular complications increases with age.

The pulse rate is generally between 60 to 100 beats per minute, but at times sinus bradycardia as low as 30 beats per minute may occur in elderly patients on reserpine or digitalis or with heightened vagal tone, or arteriosclerosis of the artery to the sinus node (Harris, 1954; 1956) or it may indicate heart block. Sometimes a pulse rate of 90 may represent an appreciable tachycardia in an aged person with a normal rate of 50.

The heart rhythm of most elderly patients with clinically normal hearts is sinus, but marked sinus arrhythmia due to arteriosclerosis of the artery to the sinoatrial node is frequently observed in the aged. Severe sinus bradycardia may be difficult to distinguish clinically from complete heart block. Both can cause vertigo syncope of the Stokes-Adams type, runs of paroxysmal ventricular tachycardia, atrial flutter or fibrillation.

Unifocal ventricular extrasystoles are usually benign, but multifocal ventricular extrasystoles indicating myocardial damage or digitalis toxicity are bad

prognostic signs foreshadowing a ventricular arrhythmia.

Frequent atrial premature contractions often herald the appearance of paroxysmal and chronic atrial fibrillation. Atrial fibrillation occurs in about 3 to 7.4 percent of the aged (Fisch, et al., 1957; Harris, 1961–a). "Lone" atrial fibrillation is almost exclusively seen in the aged. Paroxysmal or chronic atrial fibrillation in the aged is usually associated with arteriosclerosis, but may be found in rheumatic heart disease, hyperthyroidism and constrictive pericarditis.

Extra care is required during palpation and percussion to evaluate the changes due to pulmonary emphysema, kyphoscoliosis and other thoracic cage deformities. Precordial pulsations may be less prominent or absent, and thrills are less perceptible in the aged. Downward displacement of the liver due to the patient's pulmonary emphysema and kyphoscoliosis causes the liver edge to be normally felt, and the thin abdominal wall and the weak resistance of the abdominal muscles in the aged accentuate the ability of the physician to palpate the liver edge. Inexperienced physicians may call such normal livers enlarged.

Occult hyperthyroidism should be investigated in elderly patients with atrial fibrillation because it is a curable condition.

Heart block is usually due to arteriosclerosis, increased vagotonia and changes in the cardiac skeleton (Lev, 1964). Digitalis and electrolyte imbalance should always be ruled out. Complete AV heart block is far more common in patients after 60. Older patients with heart block are more susceptible to cardiac standstill and Stokes-Adams attacks than are the younger adult. Syncope is often the presenting complaint in such patients.

A slow pulse and a rigid aorta can cause a wide pulse pressure and systolic hypertension. Clinically "normal" hearts may be found in patients with hypertension of many years duration, particularly in old ladies.

The blood pressure in both arms should ordinarily not vary more than 20 mm. of mercury. Greater variation suggests significant circulatory abnormalities. The "subclavian steal" syndrome or basilar artery insufficiency should be suspected in elderly patients with cerebrovascular symptoms and a significant blood pressure difference between the right and left arm (Sproul, 1963; Toole, 1964).

Heart sounds in the aged person may be loud as in younger people, or faint and distant because of pulmonary emphysema or other abnormalities of the thoracic cage (Aravanis and Harris, 1958; Segal and Likoff, 1967). The physician must decide if distant heart sounds are due to poor function of the heart or to extracardiac causes.

Murmurs in elderly patients with valvular heart disease may be less prominent, regarded as insignificant, or occasionally absent entirely. Valvular heart disease in the aged is underdiagnosed during life. Postmortem examinations in this age group show a significantly greater amount of valvular heart disease, ranging from simple thickening and sclerosis to marked calcification, than is reported in life (Luisada and Slodki, 1965; Segal and Likoff, 1967).

Many systolic murmurs in the aged are functional. About one-third to one-half of aortic systolic murmurs in older individuals are commonly attributed to the relatively greater kinking of the aorta, and to the normal lengthening and tortuosity of the aorta in old age (Sprague, 1954). A loud systolic aortic murmur radiating into the neck and accompanied by a thrill suggests obstructive organic aortic stenosis (Leatham, 1951; Muller, 1956).

Apical systolic murmurs are more difficult to evaluate in the aged. They may be due to relative mitral insufficiency, left ventricular dilation or hypertrophy, calcareous changes of the mitral valve or organic mitral insufficiency following rheumatic fever. Calcification of the annulus of the mitral ring should always be suspected in geriatric patients with a rough systolic murmur over the apex or along the left sternal border. A harsh, systolic murmur heard loudly over the mitral area and less loudly at the aortic valve area may be due to aortic stenosis (Baker et al., 1943).

Diastolic murmurs are always abnormal. Diastolic aortic murmurs alone may be found in solitary aortic insufficiency in older persons with syphilis, arteriosclerotic heart disease, or functional dilation of the aortic ring. After the age of 60, arteriosclerosis is the most common cause of such aortic valvular disease (Boas, 1947). Aortic insufficiency frequently coexists with calcific aortic stenosis (Fenichel, 1950). Aortic insufficiency associated with mitral stenosis is usually due to rheumatic fever.

Mitral diastolic murmurs are not uncommon in the aged with rheumatic heart disease. Atherosclerotic changes frequently modify the opening snap and the usual rumbling, low pitched, mid-diastolic murmur of mitral stenosis so that the diastolic murmur of mitral stenosis is absent, evanescent or localized to a small

area. Mitral stenosis of the elderly may be benign and compatible with a long lifespan.

Congenital heart disease should not be overlooked in the aged. Ten percent of Abbott's 1000 cases with congenital heart disease were older than 50 years of age (Zeman, 1957). Aging and acquired diseases like coronary artery disease alter the more classic picture of congenital heart disease found in younger persons. Atrial septal defect is the most common type of congenital heart disease in middle and old age (Rosenthal, 1956; Leatham and Gray, 1956; Coulshed and Littler, 1957; Kelly and Lyons, 1958; Colmers, 1958; Sommer and Voudoukis, 1961; Kuzman, 1967). Patients with coarctation of the aorta may live to old age (Reifenstein et al., 1947). Patients with patent ductus arteriosus have lived to 66 years (Brody and Randell, 1935) with Ebstein's anomaly to 79 (Adams and Hudson, 1956; Vacca et al., 1958), and with congenital pulmonic stenosis to more than 57 years of age (Wild et al., 1957).

Chronic heart failure may occur without abnormal symptoms or signs in elderly patients who can lie flat in bed without difficulty. The absence of rales in aged patients with dyspnea and pulmonary congestion may cause the clinician to overlook heart failure (Seller and Brest, 1967).

X-ray examination of the heart and lungs is an integral part of every thorough examination of an elderly patient. Calcification of the aorta, pericardium, myocardium, mitral annulus, valves and coronary arteries are often found on X-ray and fluoroscopic examinations (Rytand and Lipsitch, 1946; Karsner and Koletsky, 1947; Oliver et al., 1964). Calcification of the mitral annulus is related to atherosclerosis, while calcification of the leaflets is frequently the result of previous rheumatic valvular disease. Calcification in the ventricular septum may produce heart block or prolonged conduction time. A normal sized heart does not exclude heart disease and heart failure may be present in the aged person with a small heart. Though the cardiothoracic ratio provides a reasonable index to heart size in the aged, this ratio may be abnormal because of decreased chest diameter with aging rather than an enlarged heart. At times, mild upper respiratory tract infection precipitates left ventricular failure.

An abnormal electrocardiogram without progressive changes in a patient without symptoms is not as significant as a tracing with changes in a symptomatic patient. Actually, the electrocardiogram is often normal (Fox, 1949; Fisch et al., 1957; Gelfand, 1957).

Stress tests may occasionally be necessary to diagnose heart disease. But results of exercise tests in older patients should be interpreted conservatively.

Circulation times and venous pressures are rarely of value in the aged because of decreased mental activity and delayed reaction time.

Cardiac diagnosis should pay attention to the specific etiology of underlying heart disease and to the precipitating factors. The specific etiology of heart disease in the aged is usually multiple.

TABLE 3.—*Factors Likely To Give Rise to Heart Failure in the Elderly*

A.	Infection
B.	Anemia
C.	Pneumonia
D.	Pulmonary embolus
E.	Cardiac arrhythmias and tachycardia, emotional, functional or organic
F.	Trauma
G.	Surgery
H.	Emotional stresses and strains
I.	Fever
J.	Diarrhea

Finally, the prognosis should be estimated. Older people often tolerate heart disease despite their poor cardiac reserve and their extensive multiple pathology (Harris, 1964). They get along well until extracardiac stresses overburden their heart and precipitate heart failure. Hypertension can exist for years without disability or cardiomegaly, particularly in women. Coronary artery disease and small myocardial infarctions may be less lethal in the aged who have built up extensive protective collateral circulation over the years. Angina pectoris in later life often recedes under the influence of reduced activity and richer collateral circulation. Congestive heart failure need not convey a bad prognosis in the aged. Valvular heart disease with its high mortality in the young can persist for years without seriously threatening the life of the elderly cardiac. Electrocardiographic abnormalities in the aged are less important when progressive electrocardiographic changes are absent and clinical symptoms are minimal.

COMMON FORMS OF HEART DISEASE IN THE AGED

This discussion deals with the special features of the more common forms of heart disease which result from aging and disease. The dual origin of heart disorders in old people can cause different symptoms, signs and responses than in the younger person. Furthermore, aged patients may react adversely to some drugs and are more sensitive to digitalis and other medications. Appreciation of, and attention to these differences insure better diagnosis and management of the elderly cardiac patient.

Hypertension and Hypertensive Heart Disease

Hypertension is so prevalent in the aged that many physicians consider it a normal, even inevitable, aspect of aging that does not require treatment. This view is untrue. Hypertension impairs circulation in the brain, heart and kidneys, increases cardiac work, precipitates congestive failure and aggravates arteriosclerosis. The elderly—who can least afford such effects—may benefit from antihypertensive treatment. Moderate, severe or rising hypertension always requires treatment. However, since not all tolerate or respond to vigorous therapy, it is important to select patients and treatment according to cause, severity and the general condition (Pickering, 1965; Harris, 1962; 1965 a; Schwid and Gifford, 1967).

Hypertension should be diagnosed only when a diastolic pressure over 95 mm. Hg. and a systolic pressure over 170 mm. Hg. are repeatedly found in the patient during several visits. The blood pressure in the aged patient fluctuates widely and arterial hypertension should be diagnosed only when such elevations persist. Cardiac, cerebral and other vascular stigmata of hypertension confirm the diagnosis and determine the amount of damage. Usually the physical examination and careful history provide almost all one needs to know about the patient's condition; that is, whether he has hypertension, whether he needs treatment, how vigorous his treatment should be, and what results to expect from therapy. In the physical examination funduscopic examination next to the blood pressure reading provides the most important clue to the severity of hypertension. The vessels of the fundi show slight or moderate AV nicking and tortuosity in systolic hypertension.

Standard laboratory tests, including urinanalysis and bacterial culture (the hypertensive patient often harbors a kidney infection), help to evaluate the patient's condition. The chest X-ray usually indicates the heart size, degree of tortuosity of the aorta, presence of congestive heart failure and the condition of the lungs. An electrocardiogram reveals the effect of hypertension on the heart, the state of the myocardium and hypertrophy of the heart chambers.

Renal artery obstruction due to atherosclerotic plaques should be suspected in patients over 60 who suddenly develop malignant hypertension or whose pyelogram shows a difference of 1 cm. or more between kidneys or delayed excretion of the dye from one kidney. Such differences require additional renal diagnostic studies.

People over 60 generally respond well to antihypertensive therapy without any greater incidence of side effects than in younger people, provided treatment is prescribed carefully and according to the patient's general condition and response to medication. Treatment should increase comfort and working capacity of the patient by reducing his blood pressure gradually, and only to a level that does not produce hypotensive symptoms, such as dizziness, syncope, drowsiness, restlessness or a rising blood urea nitrogen. It is necessary to re-evaluate or discontinue antihypertensive therapy if the treatment makes the patient worse or if the patient's urea nitrogen begins to rise, indicating deterioration of renal function under the lower head of pressure. Abnormalities in the electrocardiogram or cardiomegaly due to arteriosclerosis and other senescent cellular changes are likely to persist even after the blood pressure and clinical conditions return to normal with treatment.

Before resorting to drugs, it is best to begin treatment by first prescribing:

1. Weight reduction
2. Salt restriction
3. Rest

For mild hypertension it is best to prescribe the least treatment that produces results. Mild hypertension often responds to weight reduction, and a restricted salt intake of 3 to 4 grams of sodium per day (1 gram for patients with congestive heart failure). Walking and other mild activity and recreation should be encouraged and reassurance should be provided frequently.

If these measures do not control the blood pressure, antihypertensive drugs may be used. A mild antihypertensive agent such as a thiazide diuretic or reserpine

Table 4.—Antihypersensitive Drug Treatment in the Aged

Drug	Initial dose (1st 2 weeks)	Indications	Side effects
Rauwolfia Preparation:			
Resperpine	0.25 mg. b.i.d	Mild, moderate or severe systolic or diastolic hypertension.	Depression.
Alseroxylon	2 mg. b.i.d	....do	Sexual impotence.
Whole root	100 mg. b.i.d	....do	Parkinsonism.
Syrosingopine	1 mg. b.i.d	....do	Insomnia, nasal stuffiness, and diarrhea.
Diuretics:			
Chlorothiazide	250 mg. t.i.d	....do	Hypokalemia.
Flumethiazide	250 mg. t.i.d	....do	Hyponatremia.
Hydrochlorothiazide	25 mg. t.i.d	....do	Hyperuricemia.
Hydroflumethizide	2.5 mg. b.i.d	....do	Hypocalcemia.
Bendroflumethiazide	2 mg. b.i.d	....do	Hyperglycemia.
Trichlormethiazide	2 mg. b.i.d	....do	Dehydration.
Chlorthalidone	50 mg. daily (or less often).	....do	Azotemia.
Guanethidine	10 mg. daily	Moderate or severe diastolic hypertension.	Diarrhea and postural hypotension.
Methyldopa	250 mg. t.i.d	Severe diastolic hypertension.	Drowsiness, fever, weakness, liver dysfunction and granulocytopenia.

or both, with adjustment of dosages gradually to the blood pressure response, may be a beginning. If these drugs prove inadequate after 2 weeks, others may be substituted (Harris, 1965 a).

The elderly person's increased sensitivity to the effects of drugs on vascular, gastrointestinal, sphincter and autonomic nervous systems should be considered in the choice of medication. Ganglionic blocking agents, particularly those affecting the parasympathetic chain may produce urinary retention (usually in the elderly male with prostatic enlargement), constipation, diarrhea and other distressing symptoms. Diuretics should be used cautiously in the elderly patient with poor kidney function, and not at all if the patient shows increasing azotemia. Diuretics may aggravate dehydration, deplete body sodium, potassium and calcium, and elevate blood sugar and uric acid. To avoid hypokalemia, the patient should be instructed to

drink a glass of orange juice or tomato juice daily or prescribe 500 mg. of potassium for every 250 mg. of chlorothiazide. The potassium-depleted patient on digitalis is more vulnerable to digitalis toxicity.

For diastolic hypertension with cerebral manifestations or congestive heart failure, greater salt restriction (1.0 gram sodium daily), reserpine and diuretics are the treatment of choice. Since reserpine may deplete the catecholamine content of the myocardium, one must consider withdrawing it if symptomatic sinus bradycardia, other arrhythmias or progressive heart failure develops. It is important not to overlook digitalis toxicity in the elderly digitalized patient who is receiving diuretics or reserpine or who is developing hypokalemia, hypernatremia, alkalosis or azotemia. Increasing heart failure may be one manifestation of digitalis toxicity.

Small doses of ganglionic blocking agents, guanethidine, methyldopa and various monamine oxidase inhibitors may occasionally be useful. Pargyline and other potent monamine oxidase inhibitors should be avoided in elderly hypertensives.

The patient's blood pressure should be checked twice daily at the beginning of treatment and less frequently later. Consideration should be given to discontinuing the treatment if the elderly patient tolerates his hypertension better than his treatment.

Coronary Atherosclerotic Heart Disease

Atheromatosis of the coronary arteries and their branches is the most widespread cause of heart disease in the aged. It is remarkable how often extensive coronary atherosclerosis may be found at the postmortem of elderly patients without symptoms or evidence of coronary thrombosis. It is often superimposed on other forms of heart disease. Atheromatosis must not be confused with the aging process or considered an inevitable feature of aging. It is a separate, independent disease which, in time, may be conquered.

Symptoms and signs of coronary atherosclerosis generally depend upon the amount of coronary artery disease and cerebral damage. As in younger patients, angina pectoris may begin with substernal pressure, dyspnea or pain which radiates down the left arm and to the neck. In the extreme aged, reduced activity and greater collateral circulation decreased the incidence of angina pectoris. Coronary thrombosis should be suspected when angina pectoris persists or progresses. Acute coronary thrombosis is found in about 5 percent of patients in geriatric wards.

In general, an acute coronary occlusion in an older person presents with less pain but more dyspnea and congestive heart failure than in a younger person (Pathy, 1967). The infarction syndrome may not be too dramatic, consisting only of some anginal symptoms, substernal chest distress or pressure. "Silent" myocardial infarction is more common in the aged. The decreased pain is due either to the patient's brain disease or to the extensive collateral circulation in the heart built up over the years.

The treatment of asymptomatic elderly patients with coronary artery disease manifested only by electrocardiographic abnormalities is simple. They should be reassured about their prognosis and advised to follow normal health habits, avoiding undue exertion, overeating or sudden stresses. Rarely do they require medication. An abnormal electrocardiogram or slight enlargement of the heart due to coronary artery disease is no indication for intensive therapy or restriction. The aged patient with symptomatic angina pectoris should be advised to curtail his activities and to slow down his rate of performance, but encouraged to keep physically fit by walking, dancing, bowling and golfing within the limits of his cardiac tolerance. Mental and physical activities are the best antidotes for most heart conditions and for fatigue not induced by illness.

When drug therapy is necessary, nitroglycerin remains the drug of choice to relieve angina pectoris in older people. Long-acting nitrites, less clinically effective than nitroglycerin, may be tried in the elderly patient with symptomatic coronary artery disease. Since long-acting nitrites may raise the intraocular and intracranial pressures, they should be avoided in the elderly patient with glaucoma. Monoamine oxidase inhibitors may control angina pectoris in the depressed aged person. Nocturnal or decubitus angina, often a sign of early left heart failure, frequently responds to the administration of a diuretic like chlorothiazide. All elderly patients should be carefully instructed how to take their medications. Weight reducing diets and regulation of physical activity also benefit the elderly overweight patients with coronary artery disease.

Treatment of coronary thrombosis in the aged follows similar principles as in younger patients, except for the altered pharmacological responses of the aged. These general principles include:

1. Reduced work of the heart until the injured areas heal.
2. Alleviation of pain and psychic stress.

3. Application of supportive measures and drugs to maintain homeostasis of the circulatory system.
4. Prevention of serious complications.

Prolonged bed rest is always inadvisable. More than 2 weeks of strict bed rest is inadvisable in most cases, because elderly patients confined to bed for longer periods may show rapid physical deterioration, urinary incontinence, constipation and infection. Chair treatment improves pulmonary ventilation, general circulation and reduces the risks of hypostatic pneumonia, thrombophlebitis, pulmonary embolism and bed sores. Severe pain may be relieved by injecting demerol or morphine with atropine. Elderly people are sensitive to morphine and may develop respiratory depression, hypotension or urinary retention after large doses.

Congestive heart failure often complicates acute myocardial infarctions. Management of heart failure in the aged (Priest, 1957; Seller and Brest, 1967) calls for greater reliance on diuretics than on digitalis. Sodium restriction and diuretics should be started before the pulmonary congestion overwhelms the heart and produces irreversible heart failure. Digitalis may not work in the elderly with a badly damaged myocardium and the greater sensitivity of the aged cardiac to digitalis requires that smaller doses be used and that the patient be carefully observed for digitalis toxicity. If the serum potassium is low, potassium salts may be given to restore electrolyte balance. When advanced renal impairment is present, only small doses of potassium may be given, if at all. Shock must be promptly treated by the intravenous infusion or intramuscular injection of a vasopressor agent to maintain blood pressure at 90–110 mm. Hg. systolic.

Cardiac monitoring of the aged patient with acute coronary thrombosis is essential to detect early cardiac arrhythmias. Such arrhythmias are treated, as in younger people, with an appropriate agent. Digitalis toxicity and electrolyte imbalance may cause arrhythmias in the elderly digitalized patient who has suffered a myocardial infarction.

Abdominal pain developing in the elderly patient with an acute coronary thrombosis or with shock may indicate hemorrhagic infarction and necrosis of the intestines (Klegerman and Vidone, 1965).

It is preferable to treat the elderly patient with an acute coronary occlusion with early ambulation and no anticoagulants. Early ambulation reduces the complications of venous thrombosis, bed sores, pulmonary emboli, and the psychological and physiological deterioration that rapidly follow in the wake of prolonged bed rest for the senior cardiac. Such complications are more easily prevented than treated. Routine anticoagulant therapy is of little value in the average elderly patient with an acute coronary occlusion. Many old patients already have a reduced prothrombin time due to poor nutrition and liver damage or suffer from hematuria and melena which contraindicate anticoagulation therapy. Anticoagulants are best saved for elderly patients with shock, refractory heart failure, thromboembolic phenomena, a previous coronary thrombosis, or prolonged confinement to bed.

After a heart attack, the elderly patient should be encouraged to return to physical activity and social participation normally enjoyed by people of his age. Senior cardiacs can perform many sedentary jobs. Most elderly cardiac patients, especially those above 75 years of age, will not seek employment. The physician should encourage them to engage in social intercourse and community group activities. The senior cardiac has more to fear from sedation, social segregation and senility than from cardiac disease. Social intercourse and participation often benefit him more than digitalis. Although the heart of the senior cardiac may be enlarged, its rhythm irregular and its reserve diminished, it is ordinarily capable of providing sufficient cardiac output for his needs. What the senior cardiac must avoid is not activity and walking, but sudden emotional and physical stresses which can cause acute heart failure (Harris, 1965b).

Pulmonary Heart Disease

Acute cor pulmonale follows pulmonary embolism and infarction of the lungs. Elderly people are more susceptible to this complication because of more prolonged immobilization and a greater tendency to phlebothrombosis (Sharnoff and Rosenberg, 1964). About two-thirds of the patients with pulmonary emboli and acute cor pulmonale are over the age of 50. Pulmonary emboli and infarction of the lungs are twice as fatal in the aged as in younger people who display greater resiliency and homeostasis. About 75 percent of pulmonary emboli in the aged are associated with heart or central nervous system disorders. About 85 percent of emboli originate from the lower extremities, 5 percent from the abdominal and pelvic veins, 5 percent from the thorax and upper extremities, and another 5 percent from vessels in the head and neck.

Although this section emphasizes acute cor pulmonale, chronic cor pulmonale — the second most fre-

quent form of cor pulmonale — should not be overlooked as a cause of disability in elderly men and women (Fowler, 1967). It appears in the aged with chronic diseases of the lungs or of the pulmonary vessels, such as occlusion of pulmonary arteries from repeated pulmonary emboli, severe pulmonary emphysema, pulmonary fibrosis following chronic bronchitis, bronchiectasis and tuberculosis. Elderly patients with chronic cor pulmonale may die terminally from acute cor pulmonale superimposed upon the chronic form.

The diagnosis of pulmonary embolism with pulmonary infarction should always be considered in patients with tenderness and pains in the legs, suggesting thrombophlebitis, or in the metatarsal arches, indicating early phlebitis of the plantar veins. Every elderly patient with congestive heart failure unresponsive to digitalis and routine treatment should be studied for recurrent pulmonary emboli. Sudden clinical deterioration, markedly increasing dyspnea, unexplained shock, slight fever, elevated sedimentation rate, slight jaundice, chest X-ray signs simulating a pulmonary neoplasm (resembling a coin lesion), or pneumonitis may be due to a pulmonary embolus. Mental symptoms due to cerebrovascular insufficiency and reduced cardiac output may follow a pulmonary embolus in elderly patients. Pulmonary emboli may be easily mistaken for an acute myocardial infarction, since both conditions can cause arrhythmias, coronary insufficiency and sudden cardiac failure. Acute cor pulmonale often develops in the elderly hemiplegic patient with paralyzed limbs, even in the absence of clinical phlebothrombosis or thrombophlebitis. Pulmonary emboli so often complicate hip fractures that many physicians prefer to anticoagulate all patients with such fractures.

The X-ray and electrocardiographic features of pulmonary embolism with or without acute cor pulmonale are not different in the aged. The chest X-ray in patients with a massive pulmonary embolus reveals decreased vascularity of the lung fields on the affected side. In pulmonary infarction, a triangular shadow may be noted in the lung fields. Small pulmonary emboli may mimic bronchopneumonia.

The following electrocardiographic changes are noted in acute cor pulmonale in the aged (Mack et al., 1950):

1. Depressed ST segments in leads 1, 11, V 5 and V 6 (staircase variety).

2. Inverted T waves in the precordial leads from the right half of the precordium (V 2 – V 4).

3. Development of a Q 3 with a T 3 inversion. In AVF, a tiny Q wave may be present (in vertical position of the heart) or absent (in semi-horizontal position of the heart).

4. Development of right bundle branch system block, complete or incomplete.

5. Cardiac arrhythmias.

The best treatment is prophylactic early ambulation eliminating the stasis of leg veins and other complications of prolonged recumbency. Additional measures include anticoagulation of elderly patients with hip and other fractures of the lower extremities, elastic stockings and leg exercises in patients confined to bed for any more than a few days. The actual treatment of acute cor pulmonale and pulmonary emboli is the same in the aged as in younger patients and will not be discussed here.

Rheumatic Fever and Rheumatic Heart Disease

Much valvular heart disease in older people is due to rheumatic infection, syphilitic aortic insufficiency and arteriosclerosis (Bedford and Caird, 1960). Congenital lesions may also be found in this age group (Bain, 1954; Peachey and Robertson, 1965). Valvular heart disease in the aged is less correctly diagnosed because most murmurs are attributed to arteriosclerosis and other etiologies are overlooked. Valvular murmurs may be less prominent, regarded as insignificant, or absent entirely.

Acute rheumatic fever and rheumatic heart disease constitute important facets of geriatric cardiology with a relatively high incidence of activity during the fifth to eighth decades of life (Rothschild et al., 1934; Adatto et al., 1965). Postmortem and surgical studies of rheumatic heart disease disclose more active rheumatic carditis than is suspected clinically (Ferris and Myers, 1935; Cohn and Lingg, 1943; Kaufman and Poliakoff, 1950; Appel and Kossman, 1951; Soloff and Zatuchni, 1955; Caputi, 1957). After the fifth decade, acute rheumatic fever is as uncommon in the aged as in children less than five years old. The influence of age on the incidence of rheumatic fever, although as yet unexplained, is probably related to the local tissue response, the host immune mechanism, and the repeated exposure to streptococcal infections (Diehle et al., 1958).

The diagnosis of active rheumatic fever is not easy, since the classical symptoms and signs found in the young are missing in the aged. Of the 5 major modi-

fied Jones criteria, only migratory arthritis and carditis occur regularly enough in the aged to be of diagnostic value. The minor, nonspecific criteria such as increased sedimentation rate, C-reactive protein and prolonged PR interval appear in so many other conditions as to offer little or no help in diagnosing rheumatic fever in the aged (Wood, 1936). Additional difficulties in diagnosing acute rheumatic fever in the aged include the occurrence of atypical forms, and the fact that acute rheumatic myocarditis as a cause of heart failure may be obscured by hypertension, arteriosclerosis or healed rheumatic valvular disease. In addition, active rheumatic fever may be silent (Rogers and Robbins, 1947), or indistinguishable from rheumatoid arthritis which runs a similar course.

Acute rheumatic fever in the aged is recurrent and characterized by a protracted course, slight fever, moderate joint symptoms and a low incidence of cardiac damage (Kjörstad, 1957). A history of preceding streptococcal infection is frequently absent. The first episode of rheumatic fever in the aged is rarely followed by rheumatic valvular disease. The joint lesions are more persistent and disabling in the aged. Following immobilization of the joints due to the acute inflammatory process, the aged person may develop joint deformities, further osteoarthritis or other inflammatory diseases. Acute rheumatic fever in the aged usually responds well to salicylates and carries a favorable prognosis.

Smoldering clinical rheumatic carditis in patients over the age of 40 is not rare. Unexplained fever, persistent congestive failure or anomalous responses to digitalis are clues to its diagnosis. The sedimentation rate may be normal (Wood, 1936), and the antistreptolysin titre negative in rheumatic activity associated with congestive heart failure. The electrocardiogram may not help because of nonspecific patterns due to other conditions (Caputi, 1957). Besides congestive heart failure, complete heart block with Stokes-Adams syndrome has been reported in older persons with active rheumatic carditis (Greene and Bennett, 1945).

Chronic rheumatic heart disease has a high incidence and is a leading cause of death in the young and middle-aged (Cookson, 1949; Mann et al., 1950). In the aged, chronic rheumatic heart disease fortunately follows a relatively benign course, and some old patients have had known rheumatic heart disease for more than 60 years (Kløvstad, 1956; Pattavina and Currens, 1956). The relatively benign course of rheumatic heart disease with long survival in the aged is explained by:

1. A relatively milder degree of mitral stenosis.
2. Development of rheumatic fever in later life.
3. The relatively quiet, careful mode of living.
4. Probable ancestral longevity (White and Bland, 1941).

However, myocardial damage and valvular deformities from earlier attacks of rheumatic fever may remain dynamically insignificant until the addition of coronary or hypertensive cardiovascular disease in old age makes them serious (Priest, 1957).

The clinical picture of compensated rheumatic heart disease in old age is characterized by minimal cardiac lesions and frequent dyspnea and cyanosis due to emphysema, pulmonary arteriosclerosis or anemic hypoxia (Kaufman and Poliakoff, 1950). Congestive heart failure, pulmonary infarction and pneumonia are more common in elderly people than in younger people with rheumatic heart disease. The mitral valve is most often involved; the aortic valve, next. Tricuspid involvement is rare (Rosenthal and Feigin, 1947). Aortic stenosis may often be due to combined rheumatic and arteriosclerotic lesions or to arteriosclerosis alone. It is more common in old men.

Disease of the mitral valve, such as mitral stenosis, should be suspected when the electrocardiogram shows right axis deviation, rather than the left axis deviation pattern usually found in the aged. Uncomplicated mitral stenosis may remain asymptomatic until death from unrelated causes. It is 4 times more frequent in older women than in men, owing to the slower progression of coronary heart disease in women and their well-recognized greater longevity. Heart failure may develop in patients with previously asymptomatic mitral stenosis when coronary artery disease, sclerosis and calcification of rheumatic aortic lesions are superimposed upon the existing pathology of the heart. The complications of coronary artery disease and advanced calcific aortic stenosis are 2 main causes of heart failure in old age. Both increase in incidence and severity with age and develop earlier and more frequently in men than in women (Kløvstad, 1956).

No special clinical characteristics distinguished long-living patients with mitral stenosis from those living only 13 to 15 years. The best prognostic indicators are the degree of physical activity enjoyed by the patient and the presence of normal cardiac rhythm. Poor exercise tolerance and atrial fibrillation foretell early

death. Atrial fibrillation in elderly patients may be due to rheumatic mitral stenosis, coronary artery disease, hyperthyroidism or constrictive pericarditis. Adequate investigation of the atrial fibrillation in the aged requires evaluation of all these possible causes.

Treatment of active rheumatic fever and of rheumatic heart disease and their complications is the same as in younger patients except that greater care must be taken to treat associated diseases in the aged (Harris and Phelan, 1955).

Syphilitic Heart Disease

Syphilitic infection is responsible for about 10 percent of the heart disease in patients over the age of 50 (Macfarlane et al., 1956; Golden, 1959; Heggtveit, 1964). The ascending aorta is the most common site of involvement, and aortitis and aortic insufficiency are the most frequent lesions. Myocardial involvement is rare. Cardiovascular syphilis in old age may be associated with arteriosclerotic, hypertensive, rheumatic or congenital heart disease. Syphilitic aortic insufficiency has occurred with rheumatic aortic stenosis (Zeman and Storch, 1952). Although 20 years generally elapse between the development of a chancre and aortitis, acquired syphilitic aortic disease has occurred as late as 70 years after the initial infection. The first sign of congenital syphilis may not appear until after the age of 50 (Boas, 1947; Thewlis and Gale, 1948).

Syphilitic heart disease should be suspected in all obscure clinical patterns involving the heart. The diagnosis of syphilitic aortic insufficiency rests on the demonstration of dilatation of the aortic arch and the presence of a diastolic murmur arising from aortic insufficiency in a known syphilitic patient. In elderly patients with hypertension or other conditions, it may be impossible to ascertain whether the dilatation or aortic insufficiency is caused by syphilis, arteriosclerosis, or simple dynamic dilatation of the aortic ring connected with the hypertension.

Bacterial Endocarditis

Bacterial endocarditis is frequently overlooked in elderly patients with minor symptoms and signs of infection and commonplace murmurs (Wedgwood, 1955; Anderson and Staffurth, 1955). Complaints of fatigue, weight loss and anorexia are often mistakenly attributed to age rather than superimposed infection. In the aged, the portals of entry for infections producing bacterial endocarditis are the upper respiratory tract, teeth, genitourinary system and biliary tract. Some organisms enter the blood stream through suppurative foci, like pneumonia, ulcerating carcinoma, a carbuncle of the skin, a decubitus ulcer or osteomyelitis.

The high incidence of bacterial endocarditis in the aged is attributed to the decreased immunologic responses to infection, the metabolic alterations arising from changes in the aging body and increased instrumentation, especially in genitourinary disease. Furthermore, nonbacterial thrombotic vegetations involving valves, whose collagen has become dense, develop more readily under conditions of stress in the aged (Wallach et al., 1955; 1956).

Bacterial endocarditis in the aged is acute and ulcerative rather than vegetative. The bacterial cause includes a wide range of organisms in contrast to the more limited spectrum of organisms in younger people.

Glomerular lesions are less common because of the depressed sensitivity phenomena and inflammatory reaction in the debilitated patient with severe terminal infection. Bacterial endocarditis in the aged is often only an incidental terminal lesion contributing little to the clinical course or to the primary cause of death.

The diagnosis is more difficult in elderly patients whose cardiac murmurs are routinely dismissed as arteriosclerosis and whose weakness, sweats, weight loss, fever, increased sedimentation rate and anemia are symptoms common not only to bacterial endocarditis but also to many other conditions. Indispensable in making the diagnosis in elderly people are:

1. A high index of suspicion.
2. A positive blood culture.

Recurrent febrile attacks accompanied by chills, digestive disturbances or any septic symptoms warrant the assumption that an old heart lesion is the seat of new inflammation. The development of these symptoms after genitourinary manipulation or some other surgical procedure should arouse suspicion of bacterial endocarditis. Symptoms of renal or central nervous system disease, including hemiplegia, occasionally overshadow these other complaints and render diagnosis difficult. Circulatory collapse or intractable heart failure may be the only sign of this disorder. Pericarditis, enlarged liver and splenomegaly may be more common in this condition in patients over the age of 45 (Traut et al., 1949).

Blood cultures should be taken in all aged patients with vague, suspicious, puzzling or undiagnosed conditions (Bayles and Lewis, 1940). A positive culture confirms the diagnosis of bacterial endocarditis. Occasionally, elderly patients with congestive heart failure alone may show a low-grade fever. Disappearance of the fever with treatment of the heart failure points to the cardiac rather than infectious origin of this low-grade fever. Failure of the fever to respond to the treatment of the heart decompensation favors bacterial endocarditis.

Treatment of bacterial endocarditis is the same in the aged and young (Tumulty, 1967). Patients beyond the age of 50 are less likely to recover because of associated congestive heart failure, a cerebrovascular accident, recurrent embolism, chronic renal failure and occasionally uncontrolled infection (Zeman and Siegal, 1945; Lichtman and Master, 1949; Uwaydah and Weinberg, 1965).

Thyroid Heart Disorders

Hypothyroidism myxedema and hyperthyroidism are important, easily reversible thyroid disturbances frequently encountered in the aged and too often overlooked or mistakenly attributed to old age, rather than recognized as remediable diseases of the thyroid gland. The astute clinician should always consider these entities in the aged with or without heart disease.

Hypothyroid Heart Disease.—Hypothyroidism and its advanced form, myxedema, are not uncommon in older people, particularly women. Myxedema heart disease in the aged is a reversible clinico-pathologic syndrome characterized by:

1. Increased bulk of the heart muscle due to interstitial edema.
2. Pericardial effusion.
3. Sluggish contractions.
4. Muffled heart sounds and bradycardia.
5. Diminished cardiac output and lowered circulatory velocity.

The oxygen consumption is diminished, the basal metabolic rate is low, the circulation time prolonged, and the venous pressure increased. Histologically, the myocardium is grossly edematous, pericardial effusion is present, and degeneration and necrosis of the muscle fibres occur (Harris and Arvanis, 1960).

The clinical appearance of the patient should make the physician suspicious of myxedema. The elderly overweight patient with a hoarse voice, coarse facial features, puffy eyelids, slowed speech and sluggish responses permits the observant examiner to diagnose myxedema at first glance. However, the diagnosis may be missed if the wide variety of symptoms and signs, including psychotic behavior, constipation, coma, leg ulcers, arthritis and heart complaints is attributed to old age rather than to thyroid disease. Iatrogenic myxedema may develop in elderly patients sensitive to iodides (Paris et al., 1960). Since potassium iodide is prescribed for many old patients, an accurate drug history for iodides and other medications should be taken from every old person.

Once myxedema is considered, low protein bound iodine and radioactive thyroid iodide uptake studies confirm the clinical impression. However, many older people have a low basal metabolic rate and a decreased protein bound iodine. It remains uncertain whether this is normal or is actually an expression of hypothyroidism. In this situation, T–3 and T–4 column chromatography tests may provide valuable information in confirming the clinical impression. These tests tend to be low in underactivity of the thyroid gland.

Hypothyroidism and myxedema heart disease respond readily to treatment with thyroid extract or Cytomel. Elderly patients should receive initially *no* more than 10—15 mg. of thyroid or 5 micrograms of Cytomel daily. Larger doses are dangerous and may precipitate tachycardia, angina, left ventricular failure or even myocardial infarction due to the sudden increase in cardiac output produced by the effect of thyroid stimulation on an aged heart long adjusted to a low output. In questionable cases of myxedema, a therapeutic trial of thyroid helps to establish the diagnosis. After 3 to 4 weeks of therapy, the heart shadow shrinks noticeably due to the disappearance of pericardial effusion. Complete restoration to normal size requires several months of treatment.

Hyperthyroid Heart Disease.—Thyrotoxicosis is easily recognized in older people with bilateral exophthalmos, tachycardia, warm extremities and an adenomatous goiter in the neck. Masked hyperthyroidism is more difficult to diagnose in old people without these typical manifestations on physical examination. In older patients with masked hyperthyroidism, the thyroid gland may be only barely palpable and even an experienced examiner cannot feel a goiter in 2 percent of these patients. Often the evidence for hyperthyroidism is entirely cardiac and the diagnosis is overlooked. Masked hyperthyroidism should be suspected in every

elderly patient with paroxysmal or persistent atrial fibrillation of obscure or undetermined origin, unexplained sinus tachycardia, persistent high output failure despite a good cardiac regimen, and the development of digitalis toxicity prior to cardiac compensation and slowing of the heart rate. Hyperthyroidism in cardiac patients should be distinguished from subacute bacterial endocarditis, acute rheumatic and other forms of myocarditis, pericarditis, pulmonary embolism, neoplasms, diabetes mellitus and other complicated systemic disorders.

Radioactive iodine administration is the preferable treatment of hyperthyroidism in elderly cardiac patients who are poor surgical risks or who have had recurrent hyperthyroidism despite thyroidectomy. Propylthiouracil and its derivatives are also practical and effective therapeutic agents.

Surgical Treatment of Cardiovascular Disease

Many cardiovascular diseases in the aged, hitherto considered hopeless, are now amenable to surgery as a result of improved medical care, anesthetic advances and modern surgical techniques (Harris, 1961–a). The clinician, who previously paid little attention to them in the older patient, must consider and re-evaluate the treatment of these diseases in the knowledge that surgical intervention may be helpful in revascularization of the heart, repair of arteriosclerotic arterial aneurysms, occlusive vascular disease, thrombo-embolic disease, varicose veins, postphlebitic syndrome and control of arrhythmias and Stokes-Adams syndrome by artificial cardiac pacemakers (Nabatoff, 1953; Vaughn et al., 1956; Hurwitt, 1958; Cockett and Maurice, 1963; Edmunds et al., 1965; Sautter, 1965; Bowles et al., 1966).

The diagnosis of aortic aneurysm should be considered in elderly patients with an abdominal mass associated with throbbing, a sense of fullness and pain in the abdomen. The detection of a rim of calcium in the wall of the aneurysm on lateral or supine radiographic views of the abdomen is usually sufficient proof for the diagnosis. Almost all aneurysms of the abdominal aorta are arteriosclerotic and involve the portion distal to the origin of the renal artery. They can be excised and replaced by homograft or synthetic graft. Prime indications for operation are pain and abdominal discomfort. An aneurysm in a person between 50 and 55 years of age is usually rapidly progressive and should be operated upon as soon as it is detected. Asymptomatic patients over the age of 70 should not be pushed into surgery (Bahnson, 1954). Older patients between these extremes must be carefully evaluated for cardiac efficiency, renal function and coronary artery disease before a decision is reached.

A sudden rupture of a saccular aneurysm of the abdominal aorta usually calls for an emergency surgical procedure which is now more successful than in the past (Litwak et al., 1967). This complication should be suspected in any elderly patient with unexplained sudden abdominal or back pain. Fever of unexplained origin, a drop in blood hemoglobin and leukocytosis may indicate a slow retroperitoneal hemorrhage (Morgan, 1957). Three objective signs help the early diagnosis of this complication:

1. Ecchymosis in the lower abdomen or perineum (Green and Saphir, 1948).
2. Loss of deep-tendon reflexes in lower extremities (Moersch and Sayre, 1950).
3. Disappearance of psoas muscle shadow in the flat X-ray of the abdomen (Lipschutz and Chodoff, 1939).

Other surgical intervention in the aged may be beneficial. Bypass operations for segmental occlusive disease of the aorta and its branches, including the extracranial portions of the carotid arteries, the vertebral arteries, iliac and femoral arteries, have greatly improved the prognosis and comfort of elderly patients with these lesions. Immediate relief of cerebral insufficiency, claudication, peripheral arterial insufficiency, and healing of indolent ulcers frequently follow such surgical intervention. Direct attack on the heart, such as mitral commissurotomy, has been successful in elderly patients (Glover et al., 1953; Bailey and Bolton, 1956; Bowles et al., 1966). Surgical approaches to other valves remain speculative in this age group.

Constrictive pericarditis in the aged may also be corrected surgically. This condition is encountered frequently enough in the older age group to warrant the attention of the physician and the surgeon. Approximately 31 percent of all patients with constrictive pericarditis are in their sixth decade, and 2.5 percent are in the seventh and eighth decades. Although right heart failure in elderly patients is usually attributed to arteriosclerotic or rheumatic heart disease, constrictive pericarditis should be suspected in any older person with progressive right heart failure and minimal or absent left heart failure. Atrial fibrillation is also a feature of constrictive pericarditis in the aged.

Improved medical treatment and artificial cardiac pacemakers have revolutionized the treatment of cardiac arrhythmias in the aged (Humphries, 1964; Gadboys et al., 1964; Bellet, 1964; Dack, 1965; Becker et al., 1967). The well-known Stokes-Adams attack may occur during the course of marked slowing of the heart rate as a manifestation of A-V or S-A block or even sinus bradycardia. Episodes of unconsciousness may also occur in paroxysmal ventricular tachycardia or fibrillation complicating A-V block. Ventricular extrasystoles during complete A-V heart block suggest the possibility of paroxysmal ventricular arrhythmias or fibrillation as the origin of the syncopal attacks. Cardiac monitoring helps to diagnose the exact cause of the attack.

Treatment of the acute Stokes-Adams attack in the aged is no different from that in younger people. During the acute emergency, treatment includes striking the chest wall to stimulate cardiac action, external cardiac massage and artificial ventilation on the assumption that cardiac arrest is responsible for the syncope. After an electrocardiogram has been taken and the cardiac rate and rhythm have been established, the appropriate treatment can be instituted. When a cardiac pacemaker is not available to treat cardiac arrest, Isuprel, epinephrine, sodium lactate, thiazides and steroids remain the most useful agents in the medical management of acute Stokes-Adams syncope.

In all cases of heart block, the physician should make sure iatrogenic causes such as digitalis toxicity or electrolyte imbalance are not responsible for the cardiac arrest.

When an external artificial cardiac pacemaker is available, it should be used to pace the heart since it is the most effective method for rapidly restoring cardiac action. In the elderly patient too ill or too weak for operation, transvenous catheter pacemakers may be a lifesaving technique. Artificial pacemakers may also control Stokes-Adams syndrome due to ventricular arrhythmias or severe sinus bradycardia. They may also improve congestive heart failure with slow heart rates.

Experience with artificial pacemakers indicates they reduce the incidence of acute Stokes-Adams attacks and the disability from these attacks. In some aged patients with cardiac disease, other complications influence longevity, and medical management may be preferable (Cosby et al., 1966). However, electronic pacing has substantially reduced the mortality from Stokes-Adams syndrome and has significantly improved the outlook of such patients.

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AGING AND PERIPHERAL VASCULAR DISEASE

By

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INTRODUCTION

As this title indicates, the subject involves two central questions:

1. How is peripheral vascular disease delineated?
2. What are the distinctions and interrelations between aging and disease disorders of the vascular system?

There are some widely accepted views in respect to both these questions which deserve critical evaluation if progress is to be made toward an understanding of the genesis of vascular disorders which afflict the aged from which rational preventive and therapeutic measures can be developed. While vascular disorders constitute the leading cause of death in the aged, the prevalent view is that their genesis is essentially the same as in younger age groups and basic measures of prevention and therapy should also be similar. In this view, aging is considered as simply providing a sufficient period of time for a slowly developing progressive process, and that an intensification of the factors responsible for the disorder accounts for the earlier occurrence in some individuals. On the other hand, it is also possible that some vascular disorders represent the consequence of a basic aging process not presently considered in the sense of a direct etiologic factor.

THE DELINEATION OF PERIPHERAL VASCULAR DISEASE

The term "peripheral" implies that there is also a "central" vascular disease, although the latter term is not commonly used. Nevertheless, to facilitate distinctions it will be so used here.

Disorders of central involvement usually include those of the aorta, the mouths of its major branches, the coronary and cerebral circulations including the carotid arteries. The peripheral vascular disorders are generally considered to include those which involve the arterial supply to all other hollow visceral and organ systems as well as the extremities. Diseases of the pulmonary circulation are generally placed in a separate third category with no distinction between trunk and supply arteries. It is thus evident that the distinction between central and peripheral circulations rests primarily on a gross anatomic basis. There remains a gray area, namely the secondary and succeeding branches of the coronary and cerebral circulations and the vasa vasorum of the trunk arteries.

Such a delineation implies fundamental differences in structure and susceptibility to disease; otherwise there would be no rationale for such separations. To evaluate a structural basis, it is necessary to review the gross distribution and microscopic structure of the arterial system as well as some developmental considerations.

The two trunk arteries, the pulmonary artery and the aorta, emanate from the ventricles. Supply branches originate from these trunks, and as they enter the various hollow viscera and organs, they subdivide into progressively smaller branches, terminating in arterioles and capillaries which join the venous returns. In addition, the supply branches supply the walls of the large trunk arteries in the form of the vasa vasorum, and have the same relation to these trunk arteries that the coronary arteries have to the heart. In central vascular disorders which originate from the vasa vasorum, then, one is really dealing with a form of peripheral vascular disease.

Table 1 provides some data as regards certain physical and physiological characteristics of the various components of the systemic arterial system. While these data are for dogs, the basic interrelations between various components of the circulatory system hold equally for the human. Some human data are provided in Table 2, and these show some of the differences between the trunk and supply arteries.

Table 1.—Approximate Dimensions, Velocities and Resistances of Component Parts of the Arterial System of a 13 Kg. Dog.

Structure	Diameter (mm.)	Number	Total cross sectional area (cm.^{2})	Length (cm.)	Total volume (cm.^{3})	Velocity (cm./sec.)	Equivalent bifurcation [1]
Aorta	10.0	1	0.8	40.0	32	50	0
Large arteries	3.0	40	3.0	20.0	60	13.4	4
Main branches	1.0	600	5.0	10.0	50	8	9
Secondary branches	.6	1,800	5.0	4.0	20	8	11
Tertiary branches	.14	76,000	11.7	1.4	16	3.4	16
Terminal arteries	.05	1,000,000	19.6	.1	2	2	20
Terminal branches	.03	13,000,000	91.0	.15	15	.44	22
Arterioles	.02	40,000,000	125.0	.20	25	.32	23
Capillaries	.008	1,200,000,000	600.0	.10	60	.07	..

[1] An expression of relative resistance.
Data from Green, H. D.: Circulatory System. Physical Principles. In Medical Physics, Vol. II. D. Glasser, Ed. The Year Book Publ., Inc., Chicago, 1950.

Table 2.—Effective Tensions in Various Segments of the Arterial System

Vessel	Mean systolic pressure [1]	Radius [1]	Tension (dynes/cm.^{2})
Group I:			
Aorta	100 mm. Hg.	1.3 cm.	170,000
Pulmonary artery	40	1.5	78,000
Group II:			
Large arteries	100	.15	20,000
Coronary			
Splenic			
Hepatic			
Renal			
Basilar			
Group III:			
1st order branch	70	.05	4,550
2d order branch	65	.03	2,550
3d order branch	65	.02	1,700
Arteriole	60	.015	1,170
Capillary	30	.004	16

[1] Mean pressure and radius used for calculation of tensions were obtained from Glasser, O., Medical Physics Vol. 2. Aorta has been arbitrarily selected as the standard with which to compare other arteries.

Toward the end of the last century Thoma (1893) presented a series of propositions governing the development of vessels that came to be known as "Thoma's laws", and Arey (1963) considers them as relevant today as then:

1. Increase or decrease in the size of the lumen of

a vessel (or what is the same thing, the increase or decrease in the surface of the vessel wall) depends upon the rate of blood flow. (In practice, the surface ceases to grow when the blood current acquires a definite rate; the vessel increases in size when this rate is exceeded, becomes smaller when the blood stream is slowed, and disappears when it is finally arrested.)

2. Increase or decrease in the length of a vessel is governed by the tension exerted on the vessel wall in a longitudinal direction by tissues and organs outside the vessel.

3. Increase or decrease in the thickness of the vessel wall is dependent upon the blood pressure. Further, the tension of the wall is dependent on the diameter of the vessel and on its blood pressure.

4. Increase of blood pressure in capillary areas leads to the formation of new capillaries.

Thoma (1893) argued further that the metabolism of the organs primarily regulates variations in the size of capillaries, and in turn, sets in action the mechanisms that result in the increase or decrease in the size of arteries and veins.

As has been pointed out (Blumenthal, 1967-a; 1967-b), these hemodynamic factors act not only as determinants of vascular structure in a developmental sense, but also in respect to changes over time in the adult organism. While all segments of the vascular system contain the same tissue elements. i.e., endothelium and basement membrane, intimal ground substance and connective tissue, medial muscle and elastic fibers, adventitial connective tissue containing nerve fibers and the sites of penetration of the vasa vasorum into the artery wall, the quantities of these elements vary from segment to segment. Thus the trunk arteries are usually described as elastic arteries because they contain proportionally more elastic fiber than the supply arteries which contain proportionally more smooth muscle. As one moves peripherally towards the arterioles and capillaries there is a progressive diminution in both muscle and elastic fiber until in the capillary bed these elements disappear.

Fawcett (1963) has recently pointed out that there is considerable variation in capillary structure from organ to organ, particularly in respect to intercellular discontinuities and pores. He concludes, "It grows increasingly evident that no single unifying theory as to the mechanism of exchange across the capillary wall is possible. It will be necessary in the future to specify the type of capillary present in each organ before its physiology can be discussed with profit."

In point of fact, there is no abrupt anatomic change by which one could make a sharp distinction, on the basis of structure, between a trunk and a supply artery, largely because hemodynamic changes occur gradually. The first order branches emanating from the aorta contain a considerable quantity of elastic fiber; in higher order branches of the supply artery the structure consists of endothelium, intima, internal elastic membrane, media with little or no elastic fiber, external elastic membrane and adventitia.

But this kind of description implies a static structural state. In actuality, as arteries age, the intima shows a progressive increase in connective tissue and mucopolysaccharides, and even contains elastic fibrils and muscle fibers; and the media progressively "elasticizes". These changes have been categorized as indicative of a structural homeostatis (Blumenthal, 1967-a; 1967-b). With increasing age, as a result of the continual application of hemodynamic forces upon arterial walls, the vessels dilate, elongate and become tortuous. These changes result in a progressive increase in hemodynamic tensions to which the vessel wall reacts by tissue alterations which serve to maintain, at least for a time, a constant lumen/wall ratio. Ultimately this mechanism fails and the dilatation, elongation and tortuosity proceed with increased intensity. If there is a distinctive universal aging process based on the application of physical forces over time, it would be this mechanism. But these principles apply equally to the central, peripheral and pulmonary segments of the system. They are least intense in the pulmonary circulation, largely because this segment operates at a lower hemodynamic tension than the systemic circulation.

In studies dealing with chemical changes with age, Kirk (1963) has pointed out that there are significant differences between various peripheral arteries, some of which may be related to structural differences. There seems to be a basic increase in cholesterol, other lipids and calcium in all arteries, but in varying intensity. Thus with increasing age, the femoral artery shows a considerably higher concentration in these substances than age matched brachial arteries.

A third basis for distinguishing between central and peripheral vascular disorders involves the kinds of diseases to which each segment is susceptible. Prevalent concept views atherosclerosis as the principal disease of trunk arteries, along with disorders of lesser frequency such as Takayasu's (pulseless) disease, syphili-

tic and rheumatic aortitis, and cystic medial necrosis with subsequent development of dissecting aneurysm. The peripheral analogue of atherosclerosis is arteriosclerosis obliterans, although the distinction between the two is not clear. The standard textbooks of pathology view Monckeberg sclerosis (medial calcification) as mainly involving the peripheral vascular system, although in point of fact medial calcification of severe degree can involve central, as well as peripheral segments of the circulation and severe atheroma formation can also afflict both segments (Yu, 1967). Moreover, hyaline arteriolosclerosis is considered in the category of peripheral vascular disease because its most intense forms are found within organs, although equally intense arteriolosclerosis can be found in the coronary and cerebral circulations and in the vasa vasorum. Similarly, the large variety of inflammatory-immune disorders of vessels including thromboangiitis obliterans, afflict medium and small arteries, but these may also involve the vasa vasorum of trunk arteries, the coronary and cerebral circulations, as well as the arteries supplying other hollow viscera and organs.

In view of these considerations, then, the logic for the separation of diseases of the arterial system into central, peripheral and pulmonary categories remains elusive. Involved here is considerably more than semantics. In assessing the importance of aging factors in vascular disorders, if a valid distinction exists between central and peripheral vascular disorders, it is possible that aging factors might have a different influence on one than on the other. This is not likely. While this section is largely restricted to disorders of arteries supplying hollow viscera, organs and extremities, and does not include the coronary, cerebral or pulmonary segments of the circulation, or the aorta, it should be emphasized that in this author's opinion the vascular disorders considered here apply in some degree to all segments of the arterial system.

DISTINCTIONS AND INTERRELATIONS BETWEEN AGING AND DISEASE DISORDERS OF THE ARTERIAL SYSTEM

A Consideration of Vital Statistics

A review of vital statistics would appear to be a logical starting point in assessing the role of aging in vascular disease. In this regard, it has been pointed out (Blumenthal, 1964; 1968) that the Gompertz plot, which provides the standard frame of reference for the gerontologist, basically represents a composite of those disease states which show a geometric increase in incidence with advancing age. This is supported by the fact that disorders such as cardiovascular-renal disease, other forms of degenerative vascular disease, diabetes and neoplasms (by far the major causes of death in the aged) all exhibit parallel age-specific incidence curves. If this parallelism between such diverse disorders as cancer and degenerative vascular diseases has any significance, it is that these disorders may have some common underlying biological basis which in some way is linked with aging.

It may be important to attempt to elucidate such a phenomenon. The hemodynamic factors, which operate in the case of the vascular system to produce certain types of aging changes already noted, may have the general effect of reducing the oxygen supply to various organs, but this is not likely to play a directly significant role in the genesis of a disorder such as cancer. Similarly, if it is assumed that with advancing age there is a progressive deterioration in lipid tolerance (and there is much to support such a view), and that this may explain the increasing prevalence of atherosclerosis with age, it is not evident how this would influence the incidence of neoplastic disease.

The Transcription Error—Auto-Immune Concept of Aging and Vascular Disease

In several reviews (Blumenthal, 1964; 1968) the basis for the transcription error—auto-immune concept of aging has been documented. This appears to be the only current concept of aging which would provide a direct link between basic biological aging processes and aging-linked diseases. The cancer cell appears to originate as a direct consequence of the transcription error phenomenon. The auto-immune reactions, which occur in response to the presence of cells with transcription errors resulting in the production of non-self protein, involve vascular reactions. While the vascular changes are thus considered to be part of an auto-immunity originating from alterations in nonvascular cells, it is possible that vascular tissue cells may also be involved with transcription errors. In any event, it becomes important to assess the role of auto-immune vascular reactions in the genesis of degenerative vascular diseases.

These vascular reactions primarily involve intraparenchymal small arteries, arterioles and capillaries in-

cluding the vasa vasorum of trunk arteries. The lesions vary from perivascular lymphocytic cuffing, to endothelial and perithelial proliferation; to basement membrane thickening, splitting or reduplication, to fibrinoid degeneration (necrotizing arteritis), and ultimately to a state of hyalinization indistinguishable from ordinary arteriolosclerosis. The clinical entities associated with such lesions include the syndromes of allergic angiitis, lupus erythematosus, scleroderma, rheumatic and luetic vascular diseases, Takayasu's (pulseless) disease, giant cell (temporal) arteritis, periarteritis nodosa, thromboangiitis obliterans, diabetes and a variety of viral infections.

In some of these disorders, such as syphilis and presumably also allergic angiitis, the vascular reaction represents part of the immune response to a presumed or identifiable infectious or other exogenous antigenic agent. In still others, such as lupus, scleroderma and rheumatoid arthritis, there is an association with antinuclear or rheumatoid factor, or some form of paraproteinemia; all of which may represent a manifestation of a somatic mutation as postulated in the transcription error hypothesis of aging. In viral infections there may be a comparable phenomenon if one considers the likelihood that viruses become incorporated into the genetic material of cells and modify or replace genes; thus there would be cells with alterations similar to those postulated to occur on a "spontaneous" basis as an aging phenomenon in the transcription error concept. Diabetes may represent a special case in point; evidence has been presented that this disease may be the result of aging-linked transcription errors involving the synthesis of insulin by beta cells of the islets of Langerhans (Blumenthal, 1964; 1968).

Burch and associates (1966) have shown that the age-specific incidence curves for diseases such as lupus, rheumatoid arthritis, coronary heart disease, diabetes, cancer and several other basically follow variants to the Gompertz plot consistent with an auto-immune origin. While the age-specific incidence curves for these various lesions of small peripheral vessels remain to be worked out for the human, it has long been known that in rodents, periarteritis nodosa is an aging-linked phenomenon (Wilens and Sproule, 1938). Moreover, the more recent studies of Schwartz have revealed that vascular amyloid, another form of auto-immune vascular reaction, is aging-linked in the human (Schwartz, 1965).

Relation of Auto-Immune Vascular Reactions to Degenerative Vascular Diseases

A basic question regarding the role of aging is how to link these disorders of small vessels with the lesions of larger arteries and with the phenomenon of infarction which is generally the consequence of occlusion of large supply arteries. Several ways are suggested by which this may come about:

1. In large arteries, the occlusion of the vasa vasorum may result in an infarctive process of the walls, giving rise to such phenomena as subintimal hemorrhage, plaque formation and lipid accumulation. Such a phenomenon would not require an increase in circulating lipids not always present in persons with severe atherosclerosis.

2. The end-stage of these auto-immune vascular reactions, as already indicated, is hyalinization and arteriolosclerosis. Such a sequence of changes could create a progressively increasing peripheral vascular resistance and the aging-linked progressive increase in blood pressure. The latter could then serve to intensify the hemodynamic factors giving rise to the aging-linked wear and tear effects such as increasing fibrosis, elastification and calcification.

3. Vessels of the caliber primarily involved in auto-immune reactions generally provide the collateral circulation of the intrinsic blood supply of organs. The state of patency of these vessels determines whether or not occlusion of a supply artery will result in organ infarction. Therefore, occlusion of these small vessels may be the determining factor as to whether or not an infarction will occur when the principal supply artery is occluded.

What is the evidence at hand to support these various roles of small vessel lesions in the genesis of degenerative disease of larger arteries?

1. The concept that disorders of the vasa vasorum may be, at least in part, responsible for atherosclerosis of larger vessels was first put forward by Winternitz and associates (1938) and later studied in detail by Paterson (1954), Wartman (1938) and others. With the use of injection techniques, Winternitz and associates showed that with advancing age, there was increased vascularization of the artery wall followed by micro-occlusions, microhemorrhages, necrosis and lipid deposits. They noted further that wherever necrosis occurs, lipids are released and incite tissue reac-

tions analagous to atheroma, pointing to the frequent occurrence of such events in thyroid nodules. Moreover, diseases of the vasa vasorum, such as occur in syphilitic aortitis and in Takayasu's (pulseless) disease, are associated with marked intimal plaque formation. In the preoccupation over the past 30 years with the primary lipid genesis of atherosclerosis, much of the older work on the intravascular pathogenesis of the disorder has been ignored. Nevertheless, the concept that disease of the vasa vasorum may be an aging process linked with auto-immune reactions represents a recent proposal.

2. The concept that arteriolosclerosis may represent the end-stage lesion of auto-immune vascular reactions derives largely from studies in the author's laboratory. While most of these have dealt with maturity-onset diabetes, an aging-linked disorder with important associated degenerative vascular disease, the principles involved may have wider application. These studies have demonstrated that the various small vascular lesions listed above all bind anti-human globulin and anti-complement reagents, thus indicating that they contain immune globulins and complement. This holds not only for the lesions in their most active forms, but also while they are undergoing various stages of hyalinization. Ultimately, however, as the immune components are completely replaced by hyaline (fibrocollagenous) tissue, they become indistinguishable from arteriolosclerosis. The same end-stage characteristics probably apply to the lesions with perivascular amyloid observed by Schwartz (1965). It is significant that Schwartz has found the latter in the heart, brain and pancreas in about 85 percent of individuals over age 65, so that it approaches a universal human aging phenomenon.

3. The link between maturity-onset diabetes and vascular disease is particularly noteworthy because it has preoccupied and confounded researchers for over half a century. It is considered that maturity onset diabetes represents a model in which there is a direct link between a basic aging phenomenon and a definitive disease state. The literature contains evidence that with advancing years there is a deterioration in glucose tolerance in essentially all individuals. Thus this too approaches a universal biological aging phenomenon in the human and indicates that the basic difference between the biological aging process and the clinically manifest disease is really only a quantitative one. Moreover, the small vascular lesions which are angiopathies of the types listed above and are associated with diabetes, sometimes precede the onset of the biochemical disorder.

In the past there have been numerous attempts to link the intensified degenerative vascular disease of diabetes with associated defects in lipid metabolism, but lipid disorders cannot always be demonstrated even in diabetics with severe vascular disorders. More recently, doubt has also been cast on the existence of Buerger's disease. Wessler and associates (1960) maintain that this is ordinary atherosclerosis. Nevertheless, studies in the author's laboratory have revealed that in both diabetes and thromboangiitis obliterans, immunopathologic reactions indicate that there are vascular lesions of immune origin (Berns et al., 1967; Blumenthal et al., 1966; Blumenthal, 1968). In diabetes the evidence suggests that the antigen may be an altered insulin.

The problem is confounded further by the observations that diabetes is often discovered *after* the occurrence of some catastrophic event such as a myocardial infarction or gangrene of the lower extremity, so that the more knowledgeable internists and surgeons now carry out diabetic detection studies on all patients with severe degenerative vascular disease who experience such catastrophic events.

The rationale for such studies derives from information such as is represented in Table 3 and support the third contention regarding the role of small vascular lesions of immune origin. Infarctions of the organs listed in this table are, on the average, about twice as frequent among diabetics as among nondiabetics coming to autopsy; and in the case of gangrene of the lower extremity and infarction of the pituitary, the disproportion is even considerably greater.

Pancreatitis, a disease which increases in prevalence with aging and which may also be triggered by microinfarction, shows a diabetic/nondiabetic ratio similar to that found with myocardial, cerebral and renal infarction. The reason that an initiating infarction in pancreatitis is not readily detectable is that the proteolytic enzymes peculiar to this organ probably digest the infarction site beyond recognition.

Finally, the diabetic/nondiabetic ratio in respect to hypertension provides some additional support to the contention that these small vascular lesions may create an intensification of peripheral vascular resistance.

Table 3.—Incidence of Infarction and Related Phenomena in Diabetics and Nondiabetics

Site	Diabetic percent	Nondiabetic percent	Ratio diabetic/nondiabetic
Myocardial infarction	49.6	19.2	2.6/1
Cerebral infarction	30.2	19.4	1.6/1
Renal infarction	6.2	3.0	2.1/1
Pancreatitis	11.2	5.3	2.1/1
Gangrene of lower extremity	7.3	.9	8.1/1
Pituitary infarction	2.0	.2	10.0/1
Hypertension	67.8	36.3	1.6/1

Etiologic Interrelations in Peripheral Vascular Diseases

Allen, Barker and Hines (1955) classify peripheral vascular diseases in two categories: (1) functional circulatory disorders and (2) organic circulatory disorders. The functional category includes changes which are transient and reversible, such as Reynaud's phenomenon, erythermalgia and neurovascular syndromes. There are evidently no known relationships which these may bear to aging.

Organic disorders largely include those already noted, i.e., arterio-atherosclerosis, Buerger's disease, the various inflammatory-immune lesions discussed above, arterio-venous fistula and thromboembolic occlusive disease.

As to etiological considerations, these can largely be placed in four categories: (1) lipid-metabolic, (2) hemodynamic, (3) endocrine and (4) auto-immune aging.

By far the most popular view at present is that arterio-atherosclerosis is the most prevalent form of peripheral vascular disease, and that this is the consequence of a lipid-metabolic disorder. With respect to aging, it is noteworthy that there is evidence of progressive impairment of lipid tolerance with advancing years, much as there is evidence of impaired glucose tolerance. Moreover, as the studies of Kirk (1963) have shown, there is a progressive increase with advancing years in the vascular wall content of cholesterol and other lipids. In this regard, the conclusions of Hass (1963) are also noteworthy. He points out that subject to some modification because of a duration factor, the following principles generally hold regarding atheroma formation:

1. In a normal arterial system—

(a) A blood cholesterol under 350 mg.% is associated with an absence of vascular disease.

(b) A blood cholesterol between 350 and 500 mg.% is likely to be associated with diffuse involvement of all vessels much as is found in the animal made experimentally hypercholesterolemic.

(c) A blood cholesterol in excess of 500 mg.% will not only be associated with extensive vascular involvement, but also with general lipid storage disease.

2. In a degenerated arterial system—

(a) A blood cholesterol under 150 mg.% is associated with an absence of notable atheroma formation.

(b) A blood cholesterol between 150 and 250 mg.% will be associated with atheroma formation, and the distribution of the latter will be determined by the normal lipoidosis potential of the vessel and by the nature of degenerative and reparative changes already present.

(c) A blood cholesterol of 250–350 mg.% will be associated with excessive atheroma formation.

Hass concludes, "These considerations do not exclude the probability that variations from prediction should occur and that unknown and local or systemic factors must then be sought to explain them."

It becomes evident from these conclusions that aged individuals with normal blood cholesterol levels (150–250 mg.% range) may have clinically severe atherosclerosis because of a basic vascular disorder linked with 1 or more of the other 3 etiologic categories noted previously. In this regard we have already

dealt with the link between aging and the effects of hemodynamic factors, and the vascular reactions of auto-immune origin which can be linked with a basic biological aging phenomenon (transcription errors) have also already been dealt with.

In addition, certain diseases of small peripheral arteries, arterioles and capillaries, which appear to be associated with endocrine disorders, have recently been reviewed by Skelton (1963). Pathologically these lesions are similar to those already designated as those of immune origin. In the human, they are generally associated with hypertension, sometimes of the malignant type. In animals, they also occur in association with hypertension when the latter results from such diverse measures as bilateral renal artery constriction, regeneration following adrenal cortical decapsulation, dietary NaCl manipulation, or the administration of a variety of steroid hormones. Their similarity to the vascular lesions associated with auto-immune states raises the possibility that, here too, they may be of immune origin; but one can only conjecture, at present, regarding this possibility. It would involve perhaps an immunity to endogenous renin, and/or aberrant endogenous steroid production which would then act as a hapten, and/or a hapten activity of administered steroid hormones.

What is most important here is an appreciation of the fact that aging-linked peripheral vascular disease represents the end-stage of a process involving several possible etiologic categories. A lipid-metabolic defect is not a sine-qua-non and the presence of atheromatous plaques, as in the case of Buerger's disease, does not necessarily imply a lipid-metabolic disorder.

PROPHYLACTIC AND THERAPEUTIC CONSIDERATIONS

The distinction between prophylactic and therapeutic measures as currently applied to degenerative vascular disease is a hazy one. Dietary and drug measures designed to modify lipid metabolism are applied to overweight or hyperlipemic persons without manifest vascular disease, as well as to those who have experienced myocardial or cerebral infarcts, or who have intermittent claudication indicative of vascular disease of the lower extremities. The use of vasodilator and anticoagulant drugs is, in a sense, also prophylactic as well as therapeutic in their objectives. These drugs are employed in patients with such manifest symptoms as angina and intermittent claudication, as well as in individuals who have already experienced infarctive episodes. Even surgical therapy has its dual aspects. While arterial grafts are clearly therapeutic, internal mammary artery anastomosis with the coronary circulation can be considered a prophylactic measure.

Despite these modern forms of therapy and prophylaxis, including the relatively recent advent of intensive care units which have improved survival rates, an objective review of vital statistics indicates that it is unlikely there will be any significant improvement in remaining life expectancy after age 60. In fact there may even be some slight reversal of the 68–70 yrs. of life expectancy at birth because of an increasing frequency of degenerative vascular disorders in younger groups, i.e. below age 60. It is already evident that the rationalizations of the past 2–3 decades are being used to explain these developments; they are being attributed almost entirely to dietary and stress factors associated with social and political facets of our society.

The danger in this unidirectional approach is that alternatives are not receiving sufficient consideration. We have now experienced 2 to 3 decades of biomedical activity dealing with the concept of primary lipid disorders in degenerative vascular diseases without significant success.

Implied in the parallel Gompertz type curves for cancer and degenerative vascular disease, as well as in the emphasis here of the importance of immune disease of small vessels as part of a fundamental aging process in mammals, is the theory that disorders of the important supply arteries which account for such a high rate of mortality in the aged are a by-product of small vessel disease. This is an important consideration in developing prophylactic measures more directly centered on basic aging phenomena.

Comfort (1969) has recently developed a strategy in this regard, taking into account the various prevalent concepts of aging. While the restrictions of the subject matter of this discussion make a detailed review of this strategy inappropriate, Table 4 provides some idea of possible alternatives to the unidirectional strategy of the lipid metabolic derangement concept. It should be evident to the reader that none of these strategies have been applied in any significant way to the problem of degenerative vascular disease.

Table 4.—Substances Which Might Modify the Rate of Aging

Nature	Theoretical basis	Information currently available
Antioxidants	Scavenge free radicals; improves stability of information systems.	Prolongs life of experimental animals.
Radioprotectants	Assume aging similar in nature to radiation damage.	Not fully tested lifelong.
Protein synthesis inhibitors	Break "vicious circle" perpetuating transcription errors.	
Lysosome stabilizers	Prevent escape of enzymes including lysosome DNAse.	
Immunosuppression	Abolish aging effects due to autoimmune reaction.	Imuran prolongs mouse life slightly.
Anti-cross-linking agents	Aging due to crosslinks in long-term molecules.	
Hormonal agents	Retard senescent program:	
Anabolic	Prevent decline in protein storage and muscle strength.	
Somatotrophin	Maintain young pattern of protein synthesis.	
Prednisolone	Anti-autoimmune? Slow synthesis of nonsense proteins (auto-antigens.)	Doubles lifespan of a short-lived strain.
17-ketosteroids	Decline most closely parallels human senescence.	
Antimetabolic drugs	Delay synthesis of nonsense proteins, similate caloric restriction.	

CONCLUSION

It has been the intent in this discussion to avoid a conventional recitation of diseases of the supply arteries to hollow viscera, organs and extremities, and of arterioles and capillaries—the area usually covered under the category of peripheral vascular disease. Except for some reference to age distribution, the standard text-books on peripheral vascular disease virtually ignore aging as playing a significant role. Instead the choice has been made to fill this gap through emphasis on the role of fundamental aging processes which primarily involve small arteries, arterioles and capillaries.

During the latter part of the last century, when pathology began to have a significant role in medicine, degenerative vascular disease was considered to be an aging phenomenon. With the discovery that lipid containing vascular lesions could be produced in animals by dietary means, the emphasis shifted to the role of diet and lipid metabolic disorders in the human disease, almost to the exclusion of a consideration of other etiologic factors. Judging by the accomplishments of the past 30 years, it would appear that a return to the long neglected area of relating aging directly to degenerative vascular disease is in order. The basis for such a return has been documented in this presentation.

The statistical evaluation of the effectiveness of a prophylactic or therapeutic measure directed against a chronic disorder prevalent among the aged requires at least a 4 to 5-decade period. A strategy restricted to a single etiologic concept carries with it the inherent danger that as much as a half century may be lost before it becomes evident that the concept on which the strategy is based is a faulty one.

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SECTION A/DISEASES AND DISORDERS MOST RELEVANT TO SINGLE ORGAN SYSTEMS

Part V/The Bronchopulmonary System

THE AGING RESPIRATORY SYSTEM

By

Oscar J. Balchum, M.D., Ph.D.

INTRODUCTION

As man grows older, his ability to exercise and to work decreases. Much of his capacity to enjoy life rests upon an ability to be physically active.

The ultimate aim of this discussion is to relate those ways in which physical fitness for exercise may be limited by alterations in the respiratory system due to aging. With this aim in mind, a review is made of the mechanisms of changes with aging as related to structure, function, and other aspects of the lungs. It should be kept in mind, however, that the determination of the effects of aging per se is difficult because the lungs can be affected in subtle ways by the environmental factors of air pollution, including inhalation of fumes and dusts in certain occupations and by tobacco smoking. Also included in this discussion are those diseases of the lungs which have a high incidence in old age, namely bronchitis, emphysema, lung cancer and tuberculosis. These diseases are considered as the principal clinical problems encountered in older people.

Though a large number of published articles have been consulted in the preparation of this chapter, only key references will be cited. The many others can be found in the bibliographies of the latter. Difficulties in drawing clear conclusions have resulted because occupations and tobacco smoking cannot be controlled or corrected for. Also, in practically all the people that have been studied, selection of individuals closely representative of the normal aged population has not been possible. Therefore, since contradictory or differing conclusions have resulted from studies of some aspects of the aging lung, this review is an attempt to synthesize and present representative statements from available information about the subject.

CLINICAL CHARACTERISTICS

The elderly individual may go to the physician because his ability to work, walk, climb stairs or otherwise exert himself has become lessened. The normal aged person has no persistent cough or sputum production, unless he is a smoker. Shortness of breath commonly results from bursts of activity at a high rate such as fast climbing of stairs, but not exertion at a slower pace. Normal elderly individuals are therefore free from chronic respiratory symptoms. They are not short of breath unless more than moderate exertion is involved, such as running or walking at a fast rate or doing a task requiring heavy muscular exertion.

Physical Findings

Physical examination of the lungs of normal older men and women most frequently shows no abnormality. Those individuals with kyphosis, particularly when they also have short or horizontal chests, may have an increased anterior-posterior chest diameter. There may be hyperresonance upon percussion and the intensity of breath sounds may be subdued. Frequently, because of these findings such individuals are suspected as having emphysema. However, the expiratory phase of respiration is not prolonged and there is no obstructed pattern during a forced expiration.

X-Ray Findings

The chest X-ray may be read as showing hyperlucency of the lung fields. However, the bronchovascular pattern is normal and there are no blebs of bullae visible. The diaphragms are at times flattened, and may show a decreased excursion upon comparing a P–A film in expiration with one in inspiration. Though the anterior-posterior diameter also may be

somewhat increased, the picture is one of larger than normal lungs in comparison with that of younger men.

Only when hyperinflation occurs to the point of severe flattening of the diaphragms and an increased space between the posterior border of the sternum and the anterior margin of the aorta (over two inches), can one suspect the presence of obstructive pulmonary disease. In the latter individuals, there also is enlargement of the pulmonary arteries, and the decreased peripheral vascularity of the lung fields, shown by the chest roentgenogram, is not present in the chest X-ray of the normal aged person.

Ventilatory Findings

To ascertain whether the lungs are abnormal, particularly when the history, physical examination and the chest X-ray are not decisive, a spirogram must be obtained. In a man of age 60 or older the vital capacity may be somewhat below that predicted for his height (size) and age, but the FEV_1 (forced expiratory volume during the first second) is within normal limits for his age and size. The other flow rate indices such as the MEFR (maximal expiratory flow rate) are also normal.

In the normal aged person, obstruction to airflow, which is the hallmark of chronic obstructive pulmonary disease, is not present.

Upon measuring the arterial blood oxygen levels (oxygen tension, or Po_2 in mm.Hg.), it may be 75 mm. Hg. in a 60 or 65-year-old man, with an arterial oxyhemoglobin saturation of 90 to 92 percent. This level is appreciably lower than the 90 to 95 mm. Hg. (96 to 98 percent saturation) in young men. This indicates that areas of lung even though adequately perfused with blood are being underventilated, so that the blood in the pulmonary veins from such regions is not fully oxygenated; this is so-called venous admixture. When mixed with blood from better ventilated regions, the resulting arterial blood oxygen tension and saturation does not attain the levels found in younger individuals.

The uneven distribution of air to some of the alveoli, particularly those at the bases of the lungs, results in venous admixture. However, the blood carbon dioxide level (carbon dioxide tension, or Pco_2, mm. Hg.) is at normal levels (about 40 mm. Hg.), at which it remains throughout life, regardless of age. This indicates that the amount of air reaching the alveoli (alveolar ventilation, liters per minute) is normal, and is adequate to wash out the carbon dioxide from the alveolar lung spaces. The CO_2 remaining in the alveoli at somewhat higher levels in the underventilated regions of the lung bases is compensated for by overventilation of the remaining alveoli in the mid and particularly upper lung regions.

That CO_2 can be compensated for in this fashion depends upon the fact that the CO_2 dissociation curve (relationship between blood CO_2 content and tension) is practically a straight line. The less the Pco_2, the lower the CO_2 content, over a wide range of alveolar ventilation. That hyperventilated lung spaces cannot compensate for underventilated areas of lung in regard to oxygen, however, is due to the sigmoid shape of the blood oxygen dissociation curve. At higher Po_2 levels (90 mm. Hg. and above), only a relatively small amount of oxygen is taken up by hemoglobin, since the latter carries only a finite amount, contrary to the CO_2 transport system. The saturation of hemoglobin at high Po_2 levels increases only slightly therefore, and this increase is not enough to compensate for the lowered oxygen saturation of blood from poorly ventilated lung spaces.

The normal man of 55 or 60 years or more, therefore, has larger lungs—larger because they have lost some of their elasticity, or force of recoil, much like the skin does in old people. The lungs increase in size so that the amount of air left within them at the end of the deepest breath-out (residual volume) is greater than in young individuals. If there is the occurrence in the elderly person of some degree of kyphosis, an appearance of a possibly enlarged chest, decreased intensity of breath sounds, and hyperlucency of the lung fields, he may be confused upon initial inspection with an individual with chronic obstructive pulmonary disease.

It is the elasticity of the lungs or their stretch that maintains the size of the smaller bronchioles, particularly those just before the alveoli are reached (respiratory and terminal bronchioles). The pull of the surrounding alveoli, which in turn are pulled upon by the negative pleural pressure, is the means of support of small bronchioles. The loss of elastic recoil with increasing age weakens this force, which maintains the patency of the respiratory bronchioles during expiration. Closure occurs with progressively larger lung volumes as age increases. The FEV_1 decreases about 0.3 liters per decade. Since both height (as an index of size) and age are taken into account to obtain normal or "predicted" values, the FEV_1 in terms of percent of predicted values remains within normal limits in

healthy elderly individuals. The FEV_1 (forced expiratory volume), MBC (maximum breathing capacity) and other flow-rates, therefore, decrease with age and have to be corrected for the latter as well as size in determining what is normal at a given age.

CHANGE IN LUNG STRUCTURE AND FUNCTION WITH AGE

Functional alterations of the lungs and thorax have their bases in altered structure and composition of the tissues of these organs. Changes in composition take place from the moment of conception and continue throughout childhood, adolescence, and adult life into old age. The important problem is to distinguish between the time-dependent alterations of aging and those of disease which are likely to occur earlier in life and are often closely associated with the cumulative effect of both environmental factors and genetic influences.

The number of conducting airways and the segments, lobules and acini of the lungs are established at birth (Reid, 1967). The development of the alveoli continues postnatally, and reaches the adult number of about 300 million at 8 years of age, from about 20 million "air saccules" at birth (Dunnill, 1962). Elastic fibers have been seen at the mouths of the alveoli opening into respiratory bronchioli at 2 months of age. Apparently the terminal bronchioli become converted into respiratory bronchioli during the growth process. Remodeling of the pulmonary vasculature also takes place, with capillaries becoming pulmonary arterioles, and later new arteries and capillaries are formed. Many supernumerary arterial branches cut across the boundaries of the respiratory units. Interference with normal development of the thorax, such as in kyphoscoliosis, interferes with this course of development of lung structures. There are then regional differences in development which affect ventilation-perfusion relationships and homeostasis.

In the airways, goblet cells are present at about 3 months of intrauterine life, cilia begin at 10 weeks and at birth are noted in the terminal bronchioles. The submucosal mucus glands begin at the 14th week and develop even after birth.

The alveolar surface area approximates one square meter per Kg. of body weight. The oxygen uptake per minute depends upon the area of capillary surface exposed to alveolar air. It has been suggested that with aging the capillary network of the alveolar surface becomes less dense (Reid, 1967). Atypical acinar proliferation has been found with the appearance of additional channels from bronchioles analagous to the canals of Lambert, and adjacent alveoli become lined by bronchiolar epithelium (Liebow, 1962). The tissues of the aging lung therefore change, and as outlined in the foregoing pages, a decline in its functional capacity, size, and structure have been observed. But more detailed descriptions of alterations in lung tissue composition, elasticity and functioning, and the control of ventilation and capacity to exercise by older people are needed for a clear understanding of the processes which are involved.

The elasticity of the lungs is in part dependent upon the nature, properties, and arrangement of its connective tissue. This consists mainly of collagen (or fibrous protein) and elastin. The collagen is arranged as a meshwork of fibers which do not stretch to any great degree in the axis parallel to their length. However, they can be distorted laterally, and so they can accommodate to changes in the shape and size of the lung, much as does the meshwork of fibers in a nylon stocking. It may be that there is some curling, with the fibers straightening on distension of the lung with air (Schmitt, 1959).

Analysis of the lungs for dry weight, fibrous protein, and total collagen shows no change in protein content or total weight that correlates with age. There is also no evidence of changes in the polysaccharide (hexosamine) content of the lung with aging.

Kohn (1964) has proposed that the striking alterations in the physical properties and molecular aggregation of aging collagen are the foundations for the functional changes in the aging lung. There is a decline in degree of osmotic swelling or absorption of water in collagen with aging. Aging collagen becomes increasingly rigid, presumably due to an increase in the number of cross-links between its fibers. Several studies (Fitzpatrick, 1963; Boucek et al., 1961) have suggested that there is also an increased linkage of collagen with elastin in aging, with the formation of complexes. These bonds are presumably peptide in nature. The formation of new or other types of cross-links with aging is also possible, but such an occurrence has not as yet been uncovered.

Elastin or the elastic fibers are resilient, or readily regain their previous form after stretching and deformation. Elastic fibers are present in the subpleural connective tissue, in the large and small bronchi, bronchioli, alveolar ducts and around the mouths and in

the walls of the alveoli. Pierce (1963) and others have found that the total amount of elastin in the lungs increases with age, the percentage of collagen therefore decreasing and that of elastin increasing. The collagen-elastin ratio decreases with age, therefore.

It has been found that an increase in glutamic and aspartic acids in elastin occurs with aging, and perhaps also in other polar amino acids. This might account in part for the loss of the resiliency of elastin with age. The yellow color of elastin also increases with age, perhaps due to a progressive cross-linking with pigment. The nature of this yellow pigment remains unknown.

There are also changes in the pulmonary vasculature with aging. From about 20 years of age onward, there occurs a relative loss of elastic tissue in the blood vessels, and a relative increase in collagen and ground substance. The elastic fibers split and their extensibility decreases by one-half. There is a loss in smooth muscle fibers. An intimal fibrosis of the pulmonary arteries occurs, and enlargement of the pulmonary arterioles and venules takes place. A progressive arteriosclerosis with aging is seen.

It is difficult to distinguish the anatomical changes due to aging from those found in the lungs of aged individuals which might be due to influences other than aging. For example, it is said that diffuse emphysema of the lungs with excessive fenestration of and loss of septa of the alveoli occurs in 26 percent of individuals over 90 years of age. There is calcification of the cartilage of the larger bronchi and large cells of the mucus glands with granular acidic cytoplasm called onococytes are seen. There is focal parenchymal scarring, epithelial cell proliferation, and calcification of vessels and tissues. However, there is no single alteration in senile lungs not found in the lungs of younger people, at least to some degree, and there is no specific combination of changes that makes it possible to identify the aged lung with certainty.

The composite of structural alterations in connective tissue with aging described above, and particularly the alterations in the properties and distribution of elastin, result in a decrease in lung elasticity and a change in the volume pressure behavior of the lungs. Turner et al. (1968) have reported a reduction in the retractive force of the lungs with aging, the older individuals showing an increase in the FRC/TLC ratio. The FRC, or functional residual capacity, is that amount of air remaining in the lungs at the end of a normal expiration or tidal volume, and TLC means total lung capacity. It was found that the decrease in retractive force or pressure with age was almost linear at lung volumes above 30 percent of the vital capacity. At 50 percent of the total lung capacity, the transpulmonary pressure fell about 0.57 cm H_2O per year of increased age. Hartung (1957) in post-mortem lung preparations found a similar decrease of about 0.65 cm H_2O per year of aging.

Presumably, this lessened elasticity is a result of the connective tissue changes in the lungs since they influence alveolar size. There is no evidence that lung surfactant is altered by aging, but there is insufficient evidence upon which to form any real conclusion. Surfactant is a term for the properties of the very low surface tension of the thin fluid layer lining the alveoli. It is thought one of the main substances conferring this property to it is dipalmitoyl lecithin. A very low surface tension is necessary to maintain the size and shape of the alveoli, especially at low lung volumes.

Because the rate of the decrease in elastic lung recoil with aging is linear over the various lung volumes, Mead (1961) believes that a single factor is primarily implicated, presumably the elastic fiber components. The contribution to recoil or lung elasticity by elastin is greater at lower lung volumes. Collagen may serve to prevent or restrict over-distension at high lung capacity where its contribution seems to be maximal. The retractive force of the elastic fibers could change with age if there were a progressive increase in cross-linkages, a loss of branching of fibers throughout the lungs, or a combination of these. Wright (1961) has reported a progressive reduction in the number and thickness of the elastic fibers in the regions of the alveolar ducts and alveoli of the aging human lung, giving some substance to the speculations on the changes in elastic tissue arrangement or morphology.

The easier distensibility of the lungs as age increases is consistent with the observation that an increased size of the alveoli and alveolar ducts occurs in the lungs of older individuals. Consistent with this are lung volume measurements which show that the absolute FRC and RV increase with age, VC decreases and the TLC remains constant, if corrected for the size of the individual.

There is fairly general agreement that the elasticity or compliance of the chest wall decreases with age, the reduction being slightly greater than the increase in lung distensibility. This results in the total thoracic

compliance being only slightly decreased in older individuals. Turner (1968) has stated that the 60-year-old expends about 70 percent of elastic work in moving the chest wall during breathing, compared to 40 percent by the 20-year-old individual. The older person therefore has to expend a 20 percent greater energy in elastic work in order to stretch the lungs and chest wall for breathing for a given level of ventilation.

The work of breathing in the older person might also be increased by an increase in the resistance to airflow in the airways, or in the non-elastic work of breathing. Butler et al. (1960) have reported that in elderly subjects (75 to 90 years of age), airway resistance ranged from 0.7 to 2.2 cm. $H_2O/L/sec.$, as measured at FRC by body plethysmography. It was concluded that elderly individuals do not have generalized obstruction of the airways, but that the flow rates (maximum expiratory flow rate) and total pulmonary resistance may be slightly elevated due to an increase in tissue resistance. In addition, the decreased vital capacity and maximum voluntary ventilation (MVV) or MBC (maximum breathing capacity) may in addition be decreased due to a reduction in strength of the respiratory musculature with aging.

The MBC of MVV is a measure of the greatest amount of air (liters per minute) that the subject can voluntarily inhale and exhale over a short period (for 12 to 15 seconds usually, and then calculated on a minute of time basis). Involved are not only elasticity of the lung and the tissue and airway resistance, but muscle strength, agility of joint movement, as well as comprehension and motivation. It is a good measure of maximum ventilatory capacity and is related to the ventilation that can be accomplished during actual walking exercise.

To summarize: lung volume measurements indicate that there is no systematic change in total lung capacity with aging when the latter is related to body size. Vital capacity becomes reduced, and there is a concurrent increase in residual volume (Norris et al., 1956). The maximum breathing capacity (MBC) is decreased. Ventilation remains adequate to meet the demands of ordinary activity in the normal elderly person.

GASEOUS EXCHANGE AND PULMONARY CIRCULATION

Gas transfer (or pulmonary diffusing capacity) between the air in the alveoli and the pulmonary capillary blood depends upon the surface area of capillaries exposed to ventilated alveoli. The pulmonary diffusing capacity or transfer factor is an index of alveolo-capillary gas exchange for the entire lung.

A decrease in diffusing capacity with age has been noted (Cohn et al., 1954; Chosy et al., 1963), which amounts to about 8 percent per decade. Some have reported that a lesser rate of decrease with age occurs in women than in the case of men. Hamer (1962) has noted that the progressive decrement is due to an increase in membrane resistance and not to any systematic change in the blood components (number and transit time of red cells and the kinetics of the hemoglobin-oxygen reaction rate). Since there is no decrease with age either in the total number of alveoli or the total lung volume, the decrease in gas transfer may be due to a loss of lung capillaries with aging. Cohn (1964) suggested that the degree of alteration in ventilation-perfusion relationship would have to be marked in order to decrease the diffusing capacity to 70 percent of that of younger individuals, as occurs in aging. This degree of alteration in the distribution of ventilation has been observed, but seems to be of sufficient magnitude to account for only a portion of the decrease in gas transfer with aging.

With advancing age the arterial oxyhemoglobin saturation becomes slightly decreased, to about 93 to 94 percent, from the 97 to 98 percent noted in young individuals at sea level. The prime basis for this effect appears to be a non-uniformity of air distribution that becomes more accentuated with aging and is attributed to the decreased recoil forces of the aging lung. The relatively poorly ventilated areas of lung are called the "slow space" and the better ventilated areas the "fast space." The slow space has a maximum influence on arterial blood oxygen saturation. Therefore, the decreased oxyhemoglobin saturation of 3 or 4 percent that elderly individuals manifest represents a substantial inhomogeneity of the distribution of inspired air within the lungs.

In older individuals (above 50 years of age), underventilation of the alveoli of the lower lung fields or bases occurs, even during normal breathing. Gravity is an important influence because that area of lung which is dependent is more poorly ventilated, in part due to the weight of lung above it. However, it is better perfused due to the hydrostatic pressure of the weight of the volume of blood reaching from the dependent point to the right atrium. With aging, lung elasticity decreases to a point where the smaller bronchioli are not held open by the now lessened force of lung recoil.

This is particularly true when lung volumes approach the functional residual capacity (FRC) at the end of a normal expiration. Yet they are well perfused, resulting in venous admixture.

In regard to the pulmonary circulation, hemodynamic studies have shown no changes in the pulmonary vascular resistance that could be associated with aging. Dexter et al. (1964) concluded this after studying 65 individuals ages 10 to 61 (19 more than 40 years of age) by cardiac catheterization methods, but only at rest; no studies were done during exercise. The large pulmonary vascular reserve would have to be compromised more than 60 percent in order to detect any functional alterations. No reduction in pulmonary vasculature has been noted by post mortem vascular injection methods, but quantitative estimates of the number of capillaries or their surface area in regard to aging have not yet been accomplished.

HOMEOSTASIS AND VENTILATORY CONTROL

Acid-base balance, P_{CO_2}, and plasma and total blood volume do not significantly change with advancing years. However, even moderate stress may be less well handled in old age. As has been pointed out, the bellows function decreases, ventilation capacity becomes less, the lungs lose part of their retractive force, and the chest wall becomes less compliant.

With age, the metabolic rate or basal oxygen consumption decreases. The respiratory rate, to graded increases in CO_2 concentration, remains unchanged from that in young adults. Respiration is depressed to an equal extent in young and old by morphine or barbiturates. Somewhat characteristic, or more frequently seen in aged individuals, is the Cheyne-Stokes pattern of breathing during sleep, at high altitudes and with narcotics (Tenney, 1964).

EXERTIONAL CAPACITY IN THE AGED

During exercise, the minute volume of air ventilated is greater during and following exercise in older people than it is in younger individuals, relative to minute oxygen consumption. Possibly this slightly excessive ventilation is related to the greater uneveness of distribution in the lungs of older people (Norris et al., 1964; Bouhuys, 1963).

The ability to maintain a sustained work output decreases with age. Muscle strength decreases and appears to be an important factor in the lessened ventilatory ability in aging, exemplified by the decreased maximum breathing capacity. Maximum expiratory flow rate decreases with decreasing lung volumes (as airway resistance increases) more rapidly in older than in younger subjects, perhaps first noted at about age 40. This can be accounted for by a lessened elastic recoil of the lungs due usually to alterations in elastin and its distensibility. Alterations in ventilation-perfusion relationships also occur on this same basis, so that at the lung bases under-ventilated regions exist. An increased alveolo-arterial gradient exists therefore, and a lower arterial P_{O_2} occurs, compared to younger individuals.

The strength of muscular contraction decreases with age, about 15 to 35 percent, between the ages of 20 to 80 years. Speed and agility are reduced, as is manual dexterity and efficiency in walking (Robinson, 1938).

Probably the best indicator of cardiorespiratory capacity for heavy work is the maximal oxygen consumption, usually measured on a treadmill by fast walking or running until exhausted. This measurement remains quite constant for the individual, although decreased by inactivity and increased by athletic training.

The restrictions which may limit oxygen consumption are the rate of oxygen transport by the circulation, the rate of oxygen utilization by the tissues, and the diffusing capacity of the lungs. No limit to the latter has been identified in the individual with healthy lungs at any age, but the ability to ventilate the lungs may limit the oxygen consumption in aged individuals. The cardiac output, the rate of oxygen transport to the muscles, and the rate at which the working muscles utilize oxygen may be the most significant limiting factors.

The average maximal oxygen consumption of men decreases with age from 52 ml/kg in young men (ages 17 to 20 years) to 26 ml/kg at 70 to 80 years. The reserve in aerobic capacity above the oxygen demand steadily decreases with age, and is more rapid in men who are sedentary. This decrease with age is many times the increase which can result from athletic conditioning, which may average 8 ml/kg/min, for example. Moreover, the capacity for this increase also disappears with time or continued aging. During recovery from work or exercise, more oxygen is consumed than was required during rest, the so-called oxygen debt. A good portion goes to restore the energy of the anaerobic chemical systems in muscle. When the

oxygen supply is limited as in old age, the oxygen debt mechanisms cannot be as fully utilized as when oxygen supply to the muscles is adequate. Robinson (1938) has concluded that there may be factors which can limit the extent to which men who are used to a less than adequate oxygen supply can draw on anaerobic sources of energy for exertion. The levels of lactic acid accumulating in muscles of older men may result in their cessation of exercise before it is removed and distributed by the circulation. However, in older men performing sub-maximal work, the lactic acid mechanism is utilized to a greater degree, probably because of a narrower margin between oxygen requirement and oxygen consumption (Robinson, 1964; Astrand, 1952).

In regard to the physical fitness for exercise such as walking, therefore, there is no evidence that ventilation is the limiting factor in the healthy aged person. Heart rate declines with age for walking and severe exercise, reflecting a decline in physical fitness and aerobic capacity. The limiting factors for physical exertion in the aged person appears to reside in the mechanisms for oxygen transport to the working muscles, and in their ability to utilize oxygen (Astrand, 1958).

PREVALENT PULMONARY DISEASES IN THE AGED

Smoking

The cumulative impact of environment with resultant alterations in the aging individual include cigarette smoking, and in specific instances the dust and fumes of particular occupations.

Of all the factors influencing lung disease in the aged, smoking is by far the most significant. It is the major cause of chronic bronchitis (Edwards et al., 1959). Both the frequency and severity of the latter are related to the amount smoked, or rather the amount of cigarette smoke inhaled, since the association is predominantly with cigarette and not with cigar or pipe smoking, as is true also in lung cancer (Mitchell et al., 1964).

Habitual smokers have a lowered ventilatory performance evidenced by reduced flow rates on spirometry, such as a decreased forced expiratory volume in one second, and maximum breathing capacity. The residual lung volume may be moderately elevated above predicted normal levels. The pulmonary diffusing capacity is significantly lowered, compared to non-smokers. Symptoms of cough and sputum production, breathlessness upon exertion, and decreased exertional capacity are often present.

It is therefore difficult to separate the impact of a lifetime of living from that of life-long smoking. In addition, distinct structural alterations such as squamous metaplasia, loss of cilia, fibrosis and alveolar septal damage occur as a result of smoking.

Cigarette smoking is associated with a 79-percent average increase in the age specific death rate of males, and to a lesser degree in females. Even for those smoking 10 cigarettes per day, the death rate from all causes is 40 percent higher than for non-smokers, and for a two-pack a day smoker it is 120 percent higher. It is not only associated with deaths due to lung cancer, bronchitis and emphysema, but cancer of the larynx, oral cancer, esophageal cancer, as well as circulatory disease coronary artery disease and arteriosclerosis (U.S. Department of Health, Education, and Welfare, 1964; Hammond, 1962).

The diseases of the lungs of increasing prevalence in old age are tuberculosis, lung cancer, and chronic bronchitis and emphysema.

Tuberculosis

Over the past 30 years, the peak prevalence of tuberculosis has shifted from young adulthood to old age. The new active tuberculosis rate by age shows that about 33 percent of cases occurred in the age range 45–64 years in 1966, whereas in 1953, 37.4 percent occurred in the age range 25–44. The new case rate per 100,000 population in 1966 was 13.4 for ages 15–24, 28.0 for ages 25–44, 39.6 for ages 45–64, and 50.4 for ages 65 or more. The average new active tuberculosis case rate per 100,000 population was 24.4 in 1966, compared to 53.0 in 1953. In this Nation, non-whites now compose about 35 percent of all new cases reported during a year (U.S. Public Health Service, 1968).

Evidence now shows that in older persons chronic tuberculosis arises most commonly from a late reoccurrence or reactivation, with progression of dormant residuals of an initial primary tuberculosis infection implanted decades earlier (endogenous infection), rather than from a new re-infection. In young people, however, a recent history of exposure to a source of tuberculosis infection makes more likely the probability of a true exogenous (environmental) infection. Currently only 5 to 10 percent of the population is infected in childhood in the United States, as signified

by a positive (10 mm of induration, or more) intermediate strength tuberculin test, using a Purified Protein Derivative (P.P.D.).

The low positive tuberculin test rate in the younger population means that a larger proportion of young adults remains susceptible to infection if exposed to an active source. Also the infection may be totally asymptomatic or atypical, and therefore difficult to recognize. Most important, an asymptomatic and apparently harmless primary infection acquired in youth may progress to chronic destructive tuberculosis without further exposure to infection.

Conversion of the tuberculin skin test can occur without demonstrable disease, and may amount to 50 to 70 percent of new cases in some reports. Prophylactic anti-tuberculous chemotherapy is recommended in such well-documented instances of primary cases of tuberculosis, even though the chest X-ray is normal and no extrapulmonary foci are detected.

If a lesion or infiltrate is identified on the chest X-ray, sputum concentrates should be both smeared and stained for acid-fast bacilli. Cultures which will detect a lesser number of organisms and will identify atypical, as well as typical types of tuberculosis bacilli should also be made. All cultures should be tested for sensitivity to the anti-tuberculosis chemotherapy agents and anti-microbials in order to detect resistance or degree of sensitivity, even if the subject has never been on such drugs before. Initial resistance is particularly apt to occur in the atypical group of organisms, which now accounts for about 3 to 5 percent of tuberculous infections.

An older individual may therefore have a primary lung infection due to tuberculosis at any age (Stead et al., 1968). This may have the appearance of the conversion of the tuberculin skin test from negative to positive with a normal chest X-ray, or by the appearance of a pleural effusion with or without pleurisy (pleuritic pain), or a pulmonary infiltrate of pneumonia or lung nodule or density. Bacteriologic proof of the nature of the infection must be ascertained by smear and culture of the sputum for acid-fast bacilli by obtaining gastric washings for culture or by obtaining cultures of tissue biopsies appropriate to the individual case.

The greater proportion of older individuals with chronic (endogenous reactivation) active tuberculosis will have few or no symptoms, or they may have cough and sputum production which they attribute to smoking, old age, and a variety of causes. In all individuals with vague ailments as will as respiratory symptoms, and also as a part of a good medical examination in the elderly, a chest X-ray is essential.

All individuals having apical scarring, nodular infiltrate, as well as densities and cavitation should have sputum cultures for tuberculosis. A definite diagnosis can be made by these means, since indolent active tuberculosis can become activated and rapidly spread via the bronchi to destroy other areas of the lungs, or disseminate hematogenously to other areas of the body, causing tuberculous meningitis, tuberculous bone disease, renal tuberculosis, and tuberculosis of the prostrate and seminal vesicles.

Those individuals who have lesions which prove inactive by several adequate sputum or gastric-washing cultures should be seen annually for repeat chest X-ray and sputum culture follow-studies. All individuals with significant lesions who by history have had tuberculosis or who have an appreciably positive intermediate tuberculin skin test (15 mm or more in diameter) should be placed on prophylatic anti-tuberculous chemotherapy.

Lung Cancer

During the first 50 years of the nineteen hundreds, cancer mortality has more than doubled, increasing from 64 to 139 per 100,000 population. Nearly one-half of this rise has resulted from an increase in the proportion of elderly persons in the population. However, when crude mortality rates are corrected to relate to age-standardized death rates, the factor of aging of the population does not affect the trend (Dorn, 1953). Mortality from cancers of the respiratory system were infrequently reported in 1900, but now cause 9.5 percent of the total deaths from malignant neoplasms; 8.1 percent are attributed to cancer of the lungs and bronchi. The mortality rate in males is about 5 times that in females.

Respiratory cancer is predominantly a disease of late adult life, being relatively infrequent before age 40 years. After that age the death rate increases rapidly to a maximum at age 70 to 75 years in white males (Dorn, 1953). In females, the increase rises slowly but steadily throughout the remainder of the lifespan after age 40 years. At 60 to 64 years of age, the incidence rate for males compared to females is 7 to 1. The mortality rates for cancer of the lung are about 28 percent higher for whites than non-whites.

A portion of the increase is due to better diagnosis,

because elderly patients are now less often said to die of "senility" than in the early years of this century.

Chronic damage to tissues such as areas of fibrosis, chronic organizing pneumonitis and other causes of lung scarring has been recognized as an important predisposing factor (Solovay and Solovay, 1965). The tumor may surround the scar and infiltrate the adjacent areas. Although it is impossible to accurately establish, it is believed that as much as one-fourth of lung cancers are related to lung scars (Raeburn and Spencer, 1957). These may often occur in the apical scars due to healed or inactive tuberculosis lesions. In a 10-year prospective study employing chest X-rays and a symptoms questionnaire, Boucot et al. (1964) found that four-fifths of the 142 lung cancers detected in 6,137 men developed in those who had respiratory symptoms before chest X-ray changes were noted. Dyspnea was the most frequent symptom and preceded X-ray changes in half the cases. Chronic cough was next more frequent and preceded X-ray changes in 40 percent. The new lung cancers were more than twice as frequent in coughing smokers than non-coughing smokers. A sense of heaviness and chest pain preceded chest X-ray changes in 15 percent of the cancer cases (Boucot et al., 1964). A lung cancer is detectable on chest X-ray only when it has reached a size of nearly 1 cm. and contains over a billion cells. Dissemination may have already taken place even at this time.

Practically all subjects with lung cancer are smokers (90 percent or more). This close association with smoking has established the latter as the most important contributing cause of lung cancer (U.S. Department of Health, Education and Welfare, 1964). No definite association with community air pollution has as yet been uncovered, the death rates in non-smoking people being extremely low in both urban and rural communities. The death rate in Los Angeles, with its load of air pollution, in non-smokers is 8 times less than the statistically expected number and is approximately the same in both men and women, again confirming the preponderant influence of smoking.

However, heavy occupational exposures to dust containing radioactive materials, chromates, asbestos, tar and soot and nickel are accompanied by an increased incidence of bronchogenic carcinoma. Although not yet well defined and characterized, a number of occupations may be associated with an increased incidence of lung cancer (Dunn, 1955; Enterline and McKiver, 1963).

The early detection of lung cancer must be achieved by doing chest X-rays in high-risk individuals: those who are over age 40, are long-time smokers, and who have respiratory symptoms. The physician in his office by the periodic examination of the aging individual must utilize such risk factors and aim toward the earliest detection of lung cancer.

Chronic Bronchitis and Emphysema

In his original description of emphysema, Laennec did not include the senile lung as a part of that disease entity (Rappaport and Mayer, 1954). Today, most would agree and consider the lung of the aged person to have larger alveoli and an increased residual volume or size compared to the young, but to show no increase in resistance to air flow.

In no hospital autopsy service today are lungs routinely inflated by neutralized formalin or other method. Furthermore they are not examined by large lung sections in addition to microscopic methods. Emphysema is therefore being diagnosed only when the lung is appreciably involved and only a few reports are available which are the result of morphological observations on the lungs of the older person.

Emphysema has a low incidence in the non-smoking population (Dysinger and Lemon, 1963). In a study of 64,256 non-smokers, 4 deaths due to emphysema were detected, whereas 22 were expected, based on the mortality rate for men in California, which in 1960 was 9.5 per 100,000. This represents a sixfold increase from 1.5 in 1950. All had had a previous smoking history. Exposure to occupational and community air-pollution did not seem to be a factor. Others (Hammond, 1967) have evidence which suggests that occupational exposures to dust, gases and fumes is accompanied by an increased incidence of emphysema, particularly in smokers.

Men in the younger age groups, 29 to 39, have been found to have clinical and pulmonary function evidence of chronic obstructive pulmonary disease suggesting an inherent tissue defect (Seebohm and Bedell, 1963). Alpha-1 anti-trypsin deficiency has been detected in a number of men with emphysema, particularly in the younger age range of 30 to 50 years (Eriksson, 1964). The disease, emphysema, was known and detected before cigarette smoking was prevalent (Rosenblatt, 1969) and many observers have considered it to be a result of chronic bronchitis. Since instances of emphysema occur without chronic bronchitis and because of the studies regarding alpha-1 anti-trypsin deficiency, emphysema appears to be a

disease distinct from both chronic bronchitis and from the senile lung.

Chronic bronchitis is clinically evidenced by the presence of persistent cough and sputum production with or without dyspnea. Its distinction from emphysema has been made difficult by the fact that both entities frequently occur together, and because few good clinical-pathological correlative studies are available. Those reported have been usually on the very late or end stages of these diseases. Chronic bronchitis can result in airway obstruction severe enough to cause respiratory failure and death, with no emphysema being present. The clinician therefore may have a difficult time determining whether emphysema is present in addition to chronic bronchitis. Often, in such instances, the term chronic obstructive pulmonary disease is used to describe the syndrome based on the available clinical, X-ray and pulmonary function information.

In a typical instance, because of shortness of breath at work or on walking, an individual consults his physician, who notes the presence of a long history of cigarette smoking, persistent cough and excessive sputum production. Examination of the chest shows a decreased intensity of breath sounds and prolonged expiration. A chest X-ray shows hyperinflation, as evidenced by increased AP diameter, low position of the diaphragms, increased retrosternal space and a narrow or small heart. Bronchitis with obstruction to air flow is present, and probably emphysema. However, hyperinflation of the lungs, hyperlucency of the lung fields and a decreased range of movement (comparing inspiratory and expiratory films) of the diaphragms are also features of normal aging. Normal aged subjects are characterized by hyperinflation and are not readily differentiated from subjects with mild to moderate emphysema. The chest X-ray therefore has distinct limitations (Mori et al., 1964), as does the clinical examination. If an aged person with bronchitis shows obstruction to airflow upon spirometry, it would be impossible to ascertain whether he also had either senile lungs or emphysema as the parenchymal component of his lung disease, in addition to the inflammation of his airways called bronchitis.

The severity of emphysema increases progressively with age into the seventh decade, and it is presumed that the causal factors have a cumulative effect over a period of many years (Ascuy et al., 1964). An increased residual volume and decreased vital capacity are seen both in aged and emphysematous subjects, presumably due to alterations in lung elasticity occurring in both. The chief functional differences are usually a greater degree of flow resistance, more uneven ventilation of the lungs, and more diffusion impairment seen in emphysema, as compared to the changes seen with aging. The concurrence of aging and the greater severity of emphysema in old age groups often make their absolute identification impossible at the present time.

Other forms of lung destruction which produce extensive scarring with overdistension of the remaining normal lung, as in healed inactive tuberculosis, may be a cause of dyspnea, respiratory failure and even death in older individuals (Katz and Kunofsky, 1964). Since antimicrobial therapy for tuberculosis has greatly reduced mortality from this disease, a great many individuals now live on to age 60, 70 and older, and many die of this form of lung destruction, also called "emphysema."

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SECTION A/DISEASES AND DISORDERS MOST RELEVANT TO SINGLE ORGAN SYSTEMS

Part VI/The Gastrointestinal System

GASTROINTESTINAL DISEASES IN THE AGED

By

Manuel Sklar, M.D.

INTRODUCTION

The gastrointestinal tract, of all the body systems, most commonly causes chronic distress in the elderly. Moreover, fully one-half of the complaints arising from this system are of a functional nature without demonstrable organic basis. Such functional complaints often appear to be related to poor eating and bowel habits, to a preoccupation with food and elimination, to fear of disease and death, and to simply growing old. The impact of such emotional and behavioral patterns on the gastrointestinal tract can be profound, frequently constituting the sole source of an individual's complaint. However, it must not be forgotten that symptoms of functional distress often mimic those of organic disease, and careful study to distinguish between the two is thereby necessary.

This discussion of gastrointestinal disease in the aged is based upon a study of a substantial number of people over age 65, the principal findings of which are presented. All patients had primary complaints referable to the gastrointestinal tract, in 56 percent of whom a functional origin was responsible. Responsibility for complaints among the remaining were neoplasms in 10 percent, peptic ulcer in 9 percent, and a variety of conditions in the remainder.

The mortality rate due to disease of the gastrointestinal tract is about one-third that due to cardiovascular disease and is largely attributable to malignancies. However, biliary tract disease, intestinal obstruction and peptic ulcer contribute increasingly with advancing age.

Aging changes in the gastrointestinal tract do not differ from those elsewhere in that it is difficult to distinguish between those which are intrinsic and those which represent environmental effects acting over long periods. The loss of teeth may be due to environmental factors or to fundamental aging changes in the supporting gingival tissues. Likewise, the loss of taste may be due to age-related atrophy of the taste buds or to repeated trauma to these structures. Nevertheless, they may result in a loss of enjoyment in eating and consequent loss of appetite. Contributing further to this may be the aging-linked loss of the senses of sight and smell.

The stomach particularly is a site of changes with aging. Structurally speaking, histological abnormalities occur leading to a decrease in mucosal thickness and consequent atrophic gastritis. In the wall there is also an increase of leukocytes and lymphoid aggregates. Physiologically, there is an increasing incidence of achlohydria with a decline in the total volume of acid secretion in both men and women. There is considerable controversy about the relationship that may exist between the loss of secretory capacity and the occurrence of senile atrophic gastritis. In this it is generally thought there is a good possibility that neurogenic or hormonal influences play an important role. Motor activity of the stomach of older persons is also thought to be altered with diminution in hunger contractions and delayed gastric emptying.

Structural and physiological information about both the small and large intestine is not plentiful. Though it is generally agreed that there is mucosal and muscular atrophy throughout, the evidence for such thought is scanty, particularly with respect to the colon. There are little or no data on the rate of transit thru the small intestine and no firm information on intestinal secretions. With respect to the colon and rectum, which are common sites of attention because of constipation, there is no good evidence of disturbances in either motor or secretory activity.

Many studies on food balance in older people have been carried out with conflicting results. Because some persons have been found to be deficient in nitrogen, it has been assumed by a few observers that absorption of nitrogen may at times be impaired. Most investigators believe, however, that these deficits are related to intake of protein and that the older person is quite as capable of absorbing nitrogen, carbohydrate and fat as is the younger person.

Pancreatic structure in the aged person is said to show some microscopic evidence of cavity formation from coalescent locule formations brought about by proliferation of interlobular and intralobular ducts. It is not known what this means, if anything. Lipase activity of the duodenal contents, following pancreatic stimulation, is said to be decreased but this is not so with proteolytic and amyolytic enzymes.

The increase in connective tissue seen in the livers of older persons is probably the result of disease rather than being related to time. There is no real evidence that in the absence of specific liver disease, there is disturbance of liver function.

The only tangible relationship between the gall bladder and aging is with respect to the common presence of calculi and the results of cholecystic infection. Though the incidence of both stones and infection increases with advancing years, there is no evidence to suggest that either is related to an aging process.

Thus, it may be said that death of the aged person is almost never contributed to by a "wearing out" of any of the digestive organs. Even in those persons whose lives are terminated by cancer or a process of toxic or infectious nature which originate in the gastrointestinal tract, many die with a digestive system capable of sustaining life. This is due to the large reserve, both structurally and physiologically, with which each organ is endowed.

Be that as it may, organic disease cannot be completely excluded from intrinsic aging. Aging related vascular factors may be important in the origin of peptic ulcer and pancreatitis in the aged, and neoplasms may result from such a fundamental aging-linked phenomenon as somatic mutations.

Therefore, while clinicians largely view organic disease of the gastrointestinal tract in the elderly as not differing fundamentally from that in younger individuals, future research may well reveal a significant difference in origin.

SPECIFIC GASTROINTESTINAL CONDITIONS

A large group of patients over the age of 65, who presented themselves to a medical center as outpatients with complaints referable to the digestive tract, were studied carefully and observed for a year or longer following their initial visit; of this group, 56 percent were diagnosed as having functional gastrointestinal distress. Other significant causes of symptoms in this group included: gastrointestinal malignancy, 10 percent; gall bladder disease, 8 percent; duodenal ulcer, 6 percent; gastric ulcer, 3 percent; and diverticulosis of the colon, 3 percent. The remaining 14 percent had a wide variety of problems.

Functional Gastrointestinal Distress

A majority of the patients were found to have no demonstrable organic disease to which their symptoms could be attributed and were classified in the category of functional bowel distress or psychophysiologic gastrointestinal tract disturbance. These terms imply gastrointestinal symptoms of functional origin with no demonstrable anatomical changes to account for them. Because of these broader implications, such designations are preferable to such widely used terms as irritable colon, spastic colitis or mucus colitis—implying spasm and hyperirritability of the lower digestive tract.

The symptoms in this group included heartburn, ulcer-like distress, belching, nausea and vomiting. Diarrhea, constipation, flatulence and borborygmus were other prominent complaints. Most patients presented a combination of symptoms attributable to the entire gastrointestinal tract. Many complained of anorexia and weight loss, though no organic cause could be discovered.

Each patient was evaluated with a careful history, physical examination, proctosigmoidoscopy, complete gastrointestinal tract X-rays, gastric analysis, stools for occult blood, routine laboratory studies including blood count, urinalysis, sedimentation rate and, in the majority of cases, studies of hepatic function. The evaluation often was repeated once or twice because the physician strongly suspected malignancy. Since the minimum period of observation was one year or longer, the likelihood of erroneous diagnosis is thought to be small.

The factors commonly recognized as related to the development of functional bowel symptoms in the el-

derly individual include emotional tension, distress of living in the twilight years, fear of disease and death, mental depression, cerebral arteriosclerosis and the habitual use of cathartics (Jordan, 1953; Porris and King, 1952; Williamson, 1953). Although the stressful situations of living for the aged are similar to those experienced by the younger people, there are certain problems peculiar to the former. One of the most difficult is the readjustment required at the time of retirement, or, worse yet, dismissal from a position of long tenure, a situation wrought with feelings of inadequacy, uselessness and insecurity. The individual usually is called upon to adjust to a lower standard of living, perhaps even to find a new position, which is nearly an impossible task, and, if he is to avoid boredom, to develop new interests in life.

Another source of emotional difficulty occurring more commonly in women is related to the loneliness caused by the death or departure of friends and relatives. At 65, half of all women are widows; many are faced with the dilemma of living alone or as unwelcome guests of their children. Sexual frustration because of impotency or loss of the partner is not an uncommon cause of mental turmoil. A recent study of behavior patterns in a group of elderly patients revealed that a lack of sex outlet was an important source of anxiety, more so in women apparently than in men (Busse and Burne, 1954).

An exaggerated fear of death or disease, frequently described as cancer phobia, causes many individuals to seek medical advice. The chief complaint may be a symptom of long duration, previously of no great concern but now assuming life-threatening proportions. The recent death of close relatives or friends, or information gained from well-intentioned, but sometimes disturbing, lay medical literature often constitutes a precipitating event. A senile depression accompanied by digestive tract symptoms may cause a patient to seek medical care. Some patients exhibit the classical signs of senile dementia, such as confusion, poor memory or crying spells. There may be a history suggestive of a minor cerebrovascular accident; residual neurological signs may be present or absent.

The important ingredients of effective management of a patient with functional gastrointestinal distress are supportive psychotherapy, a relatively bland diet, mild sedation, antispasmodics and the newer psychoaffective drugs. Hospitalization may be of value in some cases. Psychotherapy begins with the reassurance afforded by a comprehensive diagnostic study as described previously. The completion of this type of examination with negative or normal results usually relieves the patient of much of his anxiety and allows him to benefit from the support, encouragement and understanding provided by the physician. Formal psychotherapy is seldom necessary. A sympathetic and patient physician usually is an adequate psychotherapist.

Another essential aspect of treatment is regulation of diet. The diet should be bland, designed to eliminate excessive roughage and irritating foods. Variety is of extreme importance because there is nothing so discouraging to eating, as a monotonous, tasteless diet. The diet is liberalized as improvement occurs with the gradual addition of other foods. Basically self-education is important in allowing the patient to learn the foods he can tolerate and those which will cause difficulty. Special considerations usually are necessary in patients who are chronically constipated. This problem will be discussed subsequently. In general, it is unwise to allow patients to become too preoccupied with dietary problems and bowel function. Notions with regard to diet may be tolerated as long as they do not interfere with proper nutrition or produce symptoms.

Sedatives and antispasmodics are useful adjuncts. A simple preparation containing phenobarbital and belladonna alkaloids is a good starting point. Surprisingly, most patients will tolerate one-half grain of phenobarbital three or four times a day. For those few who become drowsy, the dose of phenobarbital can be reduced. An occasional patient will complain of atropine-like effects from these preparations and, if so, these medications should be withdrawn. In general, anticholinergic agents should not be employed since the side effects of these drugs may be severe in the aged patient. The precipitation of glaucoma or urinary retention is not uncommon.

In the resistant cases not responding to the previously mentioned program, the new psychoaffective drugs may be prescribed. These drugs are apparently capable of favorably altering the mood of the patient or relieving nausea and vomiting in a nonspecific fashion. Phenothiazine drugs, such as Thorazine, Compazine, Sparine and Stelazine, to name a few, have been extremely useful in agitated patients. The antidespressant drugs, such as Marplan, Parnate and Nardil, may improve the depressed individual. Meprobamate and Librium are other useful agents for the nonspecifically irritable person who fails to respond to barbiturates or chloral hydrate. Side effects of each of these

drugs can be significant (Beckman, 1961); this text will not elaborate on this. They should not be prescribed initially, but the minimal risk involved should not mitigate against their use in the resistant patient.

Special attention is directed to one symptom which may be an overriding concern to the older person and a difficult management problem for the physician, particularly when caused by factors of purely functional origin. That symptom is constipation.

As common as is the condition in the general population, it is vastly more so among elderly persons. It may be so distressing and so difficult to manage as to push into the background all other symptoms with which the older patient may be plagued.

Doubtlessly there are many factors which contribute to constipation in this age group. Certainly loss of tone of the bowel wall, diminished peristalsis and loss of strength of the abdominal musculature are among them. More important are an inadequate intake of fluid, faulty eating habits, including improper quality of foods, and faulty habits of daily hygiene. Still more important are psychogenic influences, with anxiety and depression in the forefront of these.

Successful management of constipation in the older person demands a coordinated attack on all those contributing factors which may be remedial. However, it is of great importance to approach treatment with full expectation that time will be required to achieve results and with restraint, so that each aspect is prescribed with care. Too great and too sudden an intake of fluid, too much dietary roughage, too much physical exercise, too much laxation can have disastrous results. The older person is very likely to be frail and unable to withstand measures easily tolerated by the young, and good judgment dictates a cautious approach. Each remedial measure therefore must be undertaken with deliberate care to avoid doing more harm than good.

Gastrointestinal Malignancies

Malignant growths of the gastrointestinal tract were certainly the most serious problems encountered in the group; the diagnosis was established in approximately 11 percent of the patients. This high incidence is not surprising (Steiner, 1954). Vital statistics for the year 1950 reveal that approximately 6 percent of deaths in patients over the age of 65 years were caused by neoplasms of the digestive tract (Federal Security Agency, 1950). The greater frequency of gastrointestinal malignancy not contributing to death is suggested by an autopsy study of elderly patients dying from causes other than cancer. This revealed a 14 percent incidence of unsuspected and probably asymptomatic gastrointestinal malignancy (Howell and Piggott, 1958).

The many advances in medicine, surgery and anesthesiology have improved the prognosis and treatment of gastrointestinal cancer, but the long-term overall results continue to be poor (Marshall and Warren, 1954). In this group, 70 percent of those subjected to surgery survived and were in good health one year or more later. The series is small, but the data are in accord with other similar observations and indicate that the immediate outlook for the elderly patient with cancer is not necessarily hopeless (Editorial, 1963). These results may be improved by more frequent reexaminations perhaps facilitating earlier diagnosis. This might be accomplished by investigating minor symptoms in the aged person, rather than discounting their significance as is a common tendency.

Peptic Ulcer

Active peptic ulcer disease was diagnosed in slightly more than 10 percent of the patients, an incidence similar to that expected in younger patients. The duodenal-gastric ulcer ratio of 2 to 1 of this group is lower than the usual ratio of 8 or 10 to 1, but approximates the autopsy ratios of roughly 1 to 1 (Ivy et al., 1950).

A few patients had deformity of the duodenal bulb, but their symptoms were not those of an active ulcer. Because the number of patients with peptic ulcer is small and the period of followup relatively brief in most cases, adequate evaluation of the course and treatment of the disease in older people is not possible. However, in this series the symptoms were adequately controlled by medical management in most.

Two patients died during an episode of massive hemorrhage, one of a cerebral thrombosis and the other of acute pulmonary edema while receiving blood transfusions. These two fatalities are further evidence that the complication of bleeding is far more serious in the aged person and the mortality rate is considerably higher (Ivy et al., 1950). The need for surgery when this complication occurs, therefore, is much more urgent and probably should not be delayed beyond 48 hours if bleeding continues or if it recurs once having ceased. Medical management of this group of patients was largely based upon the Sippy principle of continuous neutralization of gastric acidity during both day and night, plus the judicious use of transfusions.

The management of a gastric ulcer is complicated by the possibility of malignancy. The initial therapeutic approach towards a newly discovered gastric ulcer is medical management if there is no evidence of malignancy as determined by radiologic, gastroscopic or cytologic examinations. In the experience of this clinic the diagnostic accuracy utilizing all three techniques exceeds 95 percent (Raskin et al., 1958). If the initial diagnostic study does not demonstrate evidence of a malignant tumor, a course of comprehensive medical management is undertaken in the hospital, with examinations repeated in 3 to 6 weeks. A therapeutic trial for 3 weeks only, as widely recommended, may be an inadequate time period for the complete healing of benign ulcer. Hence, in some cases, a somewhat longer period of therapeutic observation before resorting to surgery is preferred.

Gallbladder Disease

Diseases of the gallbladder were considered to be the primary cause of symptoms in 7.7 percent of the group. Among the patients with abnormal cholecystograms, but whose symptoms were considered not to have originated in the gallbladder, about 25 percent had organic disease elsewhere to account for their difficulty; the rest were thought to have functional bowel distress.

Surgery was performed in more than half of the symptomatic cases, about equally divided between cholecystectomy alone, and cholecystectomy combined with choledochotomy. There was no mortality. More than half of the operated patients were relieved of symptoms completely following surgery; the remainder had a recurrence of common duct stones and required reoperation or experienced no relief of symptoms whatsoever, probably because the original symptoms were unrelated to the gallbladder. Those patients who did not elect an operation were treated on a program for functional gastrointestinal distress with variable results.

A number of patients with abnormal cholecystograms gave no history of biliary colic or jaundice and were treated conservatively with the functional bowel distress regimen. In about three-fifths of these there was nearly complete disappearance of symptoms while the others continued to experience distress of variable degree. In this experience, cholecystectomy in such patients usually is followed by the persistence or recurrence of symptoms. Cholecystectomy in aged patients thus is reserved for those with definite clinical manifestations of biliary tract disease.

Rectal Polyps

Rectal polyps were discovered proctoscopically or by X-ray in 5 percent of patients. The 5 percent incidence of polyps corresponds to that of other investigators (Rider et al., 1954).

Polypectomy was performed either via the proctoscope or surgery, utilizing the anterior abdominal approach. These lesions, all of which were larger than 1 centimeter in diameter, were treated surgically, not only because of the question of malignancy, but also because they represented a possible source of bleeding. No mortality or significant morbidity occurred.

Polyps of smaller size demonstrated radiologically, not within the reach of the proctoscope, may be managed more conservatively, with repeat barium enema studies at yearly intervals. Recent studies have demonstrated that these lesions will show progressive growth if they are malignant (Figiel et al., 1963).

There has been recent controversy as to the premalignant potential of polyps of the colon. Recent studies suggest that polyps 1 centimeter in diameter or less are rarely malignant and their probability of becoming so is extremely small (Ackerman and Scott, 1963). The risk of surgery and the possibility of not finding the polyp at the time of surgery outweighs the small risk of cancer.

Diverticulosis of the Colon

Diverticula of the colon were demonstrated radiologically in about 20 percent of patients; however in only a modest number did this condition appear to be symptomatic. Clinical evidence of acute diverticulitis as manifested by localized pain and tenderness, fever and leukocytosis was present in most of the symptomatic patients; almost all responded to medical therapy consisting of sedatives, antispasmodics, analgesics, antibiotics, sulfonamides and, when necessary, intravenous fluids. One individual required a colostomy.

In a few patients with rectal bleeding in whom no other source could be found, the hemorrhage seemed attributable to diverticulosis. In each instance, conservative management proved adequate. Rarely should surgery be necessary for this complication of diverticulosis. The 5 percent incidence of bleeding in this group is similar to that reported by others (Boles and Jordan, 1958). The mechanism is not clear.

Hiatus Hernia

Hiatus hernia was thought to be clearly symptomatic in less than 1 percent of patients although the abnormality was demonstrated in a far higher percentage. More recent experience would suggest that the problem is a more common symptomatic condition than is suggested by this study (Ingelfinger, 1961). Another recent report of patients aged 60 years or older revealed an incidence of hiatus hernia of 67 percent (Berry, 1961). The vast majority, however, was asymptomatic.

The mechanism of this high incidence in the aged patients may be related to relaxation of ligaments, atrophy of muscle and fat in the esophageal hiatus, and increase in intra-abdominal pressure secondary to obesity (Berry, 1961). The sliding type of hernia is the most frequently observed.

The most common symptom is heartburn, presumably attributable to esophagitis induced by esophageal reflex. Esophagitis may ensue, producing stricture or bleeding; the latter, an uncommon complication, also may result from gastric mucosal erosion at the site of the constriction of the stomach as it passes through the diaphragm.

Treatment with a bland dry diet, elevation of the head of the bed, avoidance of tight garments, weight reduction and antacid therapy usually will control the symptoms. Surgery rarely should be necessary.

Comment

The present observations indicate that the gastrointestinal problems of the older patient do not differ greatly from those of younger people. Furthermore there is no disease attributable directly to the "wearing out" of the digestive tract. The incidence of gastric anacidity has been believed to be higher than in the general population but, since the augmented histamine or histalog tests were not employed, the incidence of true anacidity probably is much lower than has been assumed. The output of digestive enzymes may be decreased, but ample quantities remain available for digestive functions (Meyer and Necheles, 1940; Rafsky and Weingarten, 1947). Gallbladder function usually is normal in the elderly although there is a higher incidence of gallstones with increasing age. There is no significant disturbance in the histological appearance or function of the liver or pancreas that is attributable exclusively to advancing years.

The most frequent gastrointestinal problem encountered in the aged, as in any group of patients, is a functional disorder; a diagnosis tenable only after a thorough investigation has failed to disclose organic disease. Even so, a not yet clinically apparent lesion may be present, and should symptoms persist during treatment, the diagnostic examinations should be repeated. The diagnosis of organic disease has been possible occasionally, only after the third or fourth study of the same complaints. Individuals with functional distress require not only reassurance and understanding, but also patient and careful observation.

Since many patients classified as having functional digestive disturbance also had X-ray evidence of cholelithiasis, deformity of the duodenal bulb and diverticulosis of the colon, one might question a functional cause in these patients. However, critical evaluation of the symptom complex in each patient and the response to symptomatic therapy seems to exclude the clinical significance of these abnormalities.

In none of these patients was a diagnosis made of mesenteric vascular insufficiency. The symptoms of periumbilical pain occurring soon after meals, weight loss and diarrhea, usually associated with occlusive vascular disease elsewhere in the body, are considered characteristic of mesenteric vascular disease (Morris and Debakey, 1961). Steatorrhea also has been reported (Shaw and Maynard, 1958). This problem was not recognized in any of these patients; however, several who were placed in the category of functional gastrointestinal distress may indeed have been suffering from variants of this condition. Aortography usually is required to establish the diagnosis and surgery is necessary to correct the condition. Thromboendarterectomy or a vascular graft may be employed. There is no definitive medical therapy. The problem of ischemia as it affects the gastrointestinal tract is not well understood; diagnosis is difficult and definitive treatment is drastic and hazardous.

The most important organic disease of the gastrointestinal tract encountered in the aged is neoplasm, a condition whose early manifestations frequently consist of apparently trivial symptoms. Consequently, if the cancer curability rate is to be improved, minor digestive symptoms must be investigated carefully by laboratory, radiology and endoscopic methods. The clinical history alone is inadequate for this purpose, since in the aged the symptoms of benign and malignant diseases often are atypical and indistinguishable from each other.

If a lesion best treated by surgical removal is demonstrated, age per se no longer is a contraindication.

The risks of surgery in the aged have decreased considerably in recent years; the majority of patients tolerate operations exceedingly well (Glenn and Hays, 1955; Turnbull and Crile, 1954). Careful evaluation of the cardiovascular, pulmonary, renal and nutritional status must be undertaken. With these factors in mind, the decision for operation should be based upon the magnitude of the risk, the results anticipated from the procedure, and the hazards of permitting untreated disease to pursue its natural course.

SUMMARY

A group of elderly patients with gastrointestinal symptoms was studied to determine the incidence of various diseases of the digestive tract and their response to management. The commonest disorder was functional distress, a problem whose management requires patience and understanding, an appropriate diet and the judicious use of sedatives, antispasmodics and, when indicated, the so-called "tranquilizing" agents.

Malignant tumor, peptic ulcer, gallbladder disease, polyps of the rectum and colon, and diverticulitis occurred with expected frequency. Cancer surgery was surprisingly well tolerated.

Peptic ulcer is commonly encountered in the geriatric patient; medical therapy usually suffices. Bleeding secondary to ulcer, however, is of greater consequence and frequently requires surgical intervention. Utilizing currently available diagnostic methods, gastric ulcer can be differentiated from gastric carcinoma with a high degree of accuracy. A trial of strict and carefully supervised medical management is indicated in those patients in whom all the diagnostic evidence indicates a benign ulcer (Smith et al., 1953).

Gallbladder disease, if definitely symptomatic, is best managed surgically. The results of surgical treatment in patients with vague symptoms, so-called biliary dyspepsia, and an abnormal cholecystogram usually are disappointing. Such patients often are managed more effectively on a functional bowel distress regimen.

Diverticulosis of the colon is common, but is symptomatic infrequently. If acute inflammation or bleeding occurs, medical management usually suffices.

Hiatus hernia is a relatively common roentgen finding but an uncommon cause of symptoms. Medical management suffices in nearly all cases. Mesenteric vascular insufficiency may be a more common cause of symptom in the aged than now appreciated. This problem remains to be elucidated more completely.

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SECTION A/DISEASES AND DISORDERS MOST RELEVANT TO SINGLE ORGAN SYSTEMS

Part VII/The Genitourinary System

MEDICAL RENAL DISEASES IN THE AGED

By

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INTRODUCTION

The kidney in the elderly individual is affected by involuntionary processes and atrophy, secondary to atherosclerosis and probable time-related phenomena independent of disease. Superimposed on these may be numerous other renal and extrarenal diseases. All of these factors make the kidney more sensitive to sudden changes in acid/base balance and renal blood flow. The degenerative component is reflected in many ways. The blood urea nitrogen at ages 30 to 40 averages 12.9 mg.%, at age 70, 21.2 mg.%. Glomerular filtration rate and renal plasma flow at age 90 are approximately 50 percent below the values found at age 20, with major changes in this respect beginning at about age 40. Tubular function seems to be compromised more than glomerular function, and this is characteristically demonstrated by a reduced concentration ability. Also the renal compensation for an ammonium chloride induced acidosis is much slower in the aged than in younger individuals. One further abnormality is the loss of the normal diurnal excretory pattern with the development of nocturia.

While the foregoing is a fair generalization, it should be pointed out that one-third of patients 65 or older have normal glomerular and tubular function and more than two-thirds exhibit normal glomerular function.

All of this is particularly important in the elderly, because when acute illness ensues, any pre-existing renal disease or advanced involutionary process will add to the diagnostic problems and will certainly make the prognosis worse.

In addition to the progressive diminution in renal function and renal blood flow that take place as part of the aging process, the elderly individual has an increased likelihood of developing obstruction in the lower urinary tract coupled with a generally increased susceptibility of the urogenital system to infection. Further impairment of renal function may result from:

1. Inadequate fluid intake;
2. Fluid loss due to vomiting or diarrhea;
3. Hemorrhagic or traumatic shock;
4. Acute or chronic cardiac failure;
5. Septicemia due to gram negative bacteria; and
6. Injudicious use of diuretics.

THE CLINICAL EVALUATION OF RENAL FUNCTION

In order to produce urine, the kidneys are supplied with approximately one liter of blood per minute. This represents about one-fifth of the total cardiac output. One-fifth of the water and ultrafiltrable substances present in the blood plasma are filtered off by the glomerular tufts. This glomerular filtrate, amounting to approximately 120 ml./min., is concentrated by the tubules anywhere from 5 to 100 times. The tubules can concentrate certain substances more than others. By modifying the composition of the urine during its passage through the tubules, the kidney is able to control body water, electrolyte and acid/base equilibrium.

The kidney is perhaps the most serviceable organ with respect to maintaining homeostasis. It often reacts to changes of plasma electrolyte levels, however, without taking into account such problems as intracellular depletion. This is especially dangerous in the case of potassium which has its highest concentration in the intracellular compartment. During alkalotic and cata-

bolic states, potassium may be released from the cells. The kidney, like a permissive parent, readily excretes this ion, thereby allowing a severe total body depletion to develop.

There are many tests of renal function, but a simple urinalysis—with the sediment, at least, done preferably by the physician himself—will always give valuable information. This may prove to be even more useful than the results of complicated clearance, renal blood flow and radioisotope studies. It has been repeatedly demonstrated that proteinuria and an abnormal sediment are among the earliest signs of chronic renal disease, and these findings are often evident long before any azotemia or impaired concentration ability can be detected.

Urinalysis

The minimal obligatory urine volume is at least 300–400 ml./day. Dehydration alone will rarely produce an output less than 300 ml./day. Since early diagnosis is imperative, particularly in dealing with an acute renal failure, the concept of oliguria has been broadened to include any fall in output below 20 ml./hour. The complete absence of urine is usually due to obstruction or a massive nephrotoxic reaction. Advanced chronic renal diseases may lead to loss of concentration power which can only be compensated by large outputs of over two liters of urine daily. This may be accompanied by significant sodium loss (salt losing nephritis). The syndrome of a rising BUN with a more than adequate urinary output is associated very frequently with the low potassium syndromes. Outputs of 5 and 6 liters suggest either diabetes insipidus or compulsive water drinking. Diabetes insipidus can be virtually excluded if the patient can sleep undisturbed without any urge to drink.

Specific gravity reflects osmolarity which is determined by the presence in the urine of substances of low molecular weight such as urea, potassium, sodium and glucose. However, before drawing any conclusion from a low specific gravity, it should be ascertained whether the patient is on a protein or sodium restricted diet and that he has not received a diuretic, because any of these factors may in themselves produce low values.

The tests for *glucose* and *protein* are well known and have been greatly simplified by the "dip stick" methods. Most of the "dip stick" tests are specific for glucose and will not react with fructose, galactose or pentoses. Rather frequently, urines contain peroxidases which give the same dip stick reactions as glucose. The tests for protein are not specific, giving positive reactions with both albumin and globulin. For some reason, as yet unexplained, the "dip sticks" do not give positive reactions with Bence Jones protein which may be the only hint of the presence of multiple myeloma. Therefore, if the "dip sticks" constitute the only test for protein in a clinical laboratory, many cases of myeloma will be missed, especially since patients who excrete Bence Jones protein, rather often do not have abnormal serum globulins.

In elderly individuals, 1+ proteinuria in the presence of a negative sediment examination may be accepted as being of no diagnostic significance.

The examination of the sediment should be made on a *fresh* morning urine, preferably after water has been withheld for at least ten hours. The casts, because of their mass, will concentrate at the edges of the cover slip. Casts originate within the renal tubules and their presence excludes uncomplicated cystitis or urethritis. Red blood cell casts suggest the presence of glomerulitis, and white cell casts indicate purulent disease within the kidney. Casts containing tubular epithelium suggest a degenerative process. Waxy casts (homogeneous with high refractive index and wavy outline) and granular casts are generally seen only in chronic renal disease. The presence of fat droplets in a cellular cast suggests fatty tubular degeneration. If these droplets are birefringent in polarized light, the diagnosis of a nephrotic syndrome is practically certain. The presence of sulfa crystals suggests the injudicious use of sulfonamides as the cause of a renal syndrome.

A random sediment simultaneously showing evidence of acute disease (RBC's, WBC's, hyaline and cellular casts), subacute disease (fatty casts, fat droplets, oval fat bodies and doubly refractile bodies), and chronic disease (granular, waxy and broad red cell casts) is referred to as a telescoped sediment. It is seen most frequently in lupus erythematosus, polyarteritis nodosa, focal necrotising glomerulonephritis, and acute exacerbations in the subchronic (nephrotic) phase of glomerulonephritis.

Blood Chemistry

Actually every test, even endocrine and liver function tests, may contribute to the understanding of a renal problem, but some of the analyses are of special importance and merit separate emphasis.

Blood urea nitrogen (BUN) reflects the interaction between the patient's diet and his impaired function.

By limiting protein in the diet, an elevated blood urea nitrogen may be appreciably reduced. Van Slyke indicated that a statistically significant rise in the blood urea nitrogen does not occur until 75 percent of renal function has been lost. In the light of this finding, it would appear that the BUN is by no means an early test of impaired renal function. A disproportionate rise in blood urea nitrogen compared to creatinine is suggestive of prerenal azotemia, usually the result of dehydration or blood loss.

In uremia, uric acid rises along with the blood urea nitrogen and creatinine. It is in itself, however, disproportionately high in all forms of gout. In uremic states, phosphorus tends to be elevated and calcium depressed. If the serum calcium is high or even normal, one must think of primary hyperparathyroidism with hypercalciuria and nephrocalcinosis as the cause of the uremia.

Tests of Glomerular Function (Clearance)

The clearance tests are all mainly research tools. Such tests are excellent in studying function in rapidly changing acute diseases states, e.g., acute glomerulonephritis; on the other hand, they are of little help in analyzing the complicated disease states of the aged.

Tests of Tubular Function

Contrary to frequently made statements, the phenolsulfonphthalein test (PSP) does not measure tubular function. Because the quantity of PSP injected is so small that it can be excreted even by diseased tubules, the test is more related to measurement of effective renal blood flow than anything else. Binding of injected PSP to plasma proteins plays, as in all dye tests, an important role. In cases of nephrosis, since the albumin is low and binding is imperfect, as much as 70 percent of the dye may be excreted in the first 15 minutes. The patient must be adequately hydrated and must not have received any diuretics prior to the test. Under most circumstances the first 15-minute specimen is the critical one and should contain more than 15 percent of the dye. At the end of an hour, 40 to 50 percent should have been excreted and at the end of two hours, 60 to 75 percent. If the 15-minute specimen is low but the one-hour specimen is normal, obstructive uropathy should be considered. Unlike clearance tests, this is not a good test for following progressive changes.

The *concentration test* is performed after fluids have been restricted 12 hours. During the next 4 hours, the specific gravity (S.G.) should rise to 1.022–1.032. The patient should not be on diuretics and should have received adequate protein and salt in his diet. Results must be corrected for the presence of sugar and albumin. If the specific gravity of the urine does not rise above that of the plasma (1.010–1.012), this is referred to as isosthenuria, and is characteristic of tubular disease, glomerulosclerosis, diabetes insipidus, and obstructive uropathy.

Interpreting results and applying therapeutic deductions require flexibility. The purpose of therapy is not to correct abnormal serum chemical concentrations, but to make a sick patient well. Particularly with respect to electrolytes, a distinction must be made between serum levels and total body concentration. In many instances the presence of clinical abnormalities such as nausea, muscular flaccidity and hyperventilation are more important than laboratory figures.

RENAL DISEASE IN THE AGED

In this discussion, our main concern will be with four groups of nephropathies:

1. Infectious—pyelonephritis;
2. Immunologic reactions—including glomerulonephritis and vasculitis;
3. Degenerative disease—including arteriosclerosis, hypertension, and diabetes; and
4. Tubular diseases and nephrolithiasis.

Finally, the syndrome of renal failure, i.e., the end stage of much renal disease, will be analyzed.

Pyelonephritis

This entity is probably the most common renal disease in the aged male. The underlying cause is usually obstruction due to bladder neck pathology. Pyelonephritis is frequently responsible for acute failure in chronic renal disease, and if it can be treated, the failure may be at least temporarily reversed. Knowledge of this disease is just now beginning to be extended. Now it is not even certain that for the disease to be progressive, active infection by micro-organisms must be continually present, especially in the later stages. Auto-immune mechanisms are now believed to play an important role.

Bacterial colony counts have been helpful in demonstrating that serious infection may be present in the absence of fever, dysuria, frequency or pyuria. Counts up to 10,000 col./ml. may reflect the presence of mi-

croorganisms which live as saprophytes in the terminal part of the urethra. It should also be kept in mind that such a count may represent accidental contamination of the specimen. Counts of 100,000 col./ml. or more are believed by some physicians to indicate that an infection must be present involving kidneys, bladder or urethra, although there is not general agreement even on this point. The technique of colony counting makes a midstream urine acceptable for bacteriologic examination, provided that cultures are made within an hour after voiding and no obstruction is present. If meticulous technique is observed, catheterization can be avoided.

The most common bacterial pathogens are E. coli, B. aerogenosa and B. proteus, although gram positive organisms, particularly staphylococci, are being found with increasing frequency. The problem today in each institution are the changes in predominant bacterial flora with ever varying degrees of antibiotic and chemotherapeutic resistance.

Tuberculosis of the kidney—although rare nowadays—must still be considered in all cases of chronic pyelonephritis, particularly if routine urine cultures remain sterile, although the sediment continuously suggests the presence of infection. The reaction of the urine will usually be acid. A 24-hour urine should be sent to the bacteriologist for inoculation on special media, after the sediment of the urine has been exposed to a strong mineral acid. Unless the latter precaution is taken, non-tuberculous acid fast bacilli, especially smegma bacilli, can cause serious and embarrassing diagnostic errors.

Adequate therapy requires first and foremost correction of the causative factors which have led to the bacterial infection. This calls for the relief of obstruction, the control of diabetes when present, and the improvement of general health. Indiscriminate use of antibiotics in a patient with urinary tract obstruction will only produce resistant organisms. The possible causes of obstruction are many and include phimosis, urethral stricture, bladder neck fibrosis, prostatic hypertrophy, prostatic carcinoma, interstitial cystitis with contraction of the bladder, bladder tumor, ureteral stricture, ureteral calculi, pelvic tumor, ureteropelvic obstruction and tumor of the renal pelvis. A urologic examination is therefore mandatory in every patient including those with chronic pyelonephritis. Following sensitivity studies, the patient should be placed on specific antibiotic therapy. Needless to say, the presence of tuberculosis calls for combined therapy with Isoniazid, Para Aminosalicylic Acid (PAS), and Streptomycin.

Most antibiotics and chemotherapeutic agents are not excreted in high concentration in the urine once azotemia develops. Such antibiotics as kanamycin, bacitracin, neomycin and polymyxin are in themselves nephrotoxic and should not be used in patients with renal insufficiency. The blood levels of vancomycin, kanamycin, neomycin and streptomycin rise precipitously in patients with renal failure and as a result, may produce severe complications, especially rapid vestibular damage and deafness. Usually this damage is already irreversible with the onset of the first symptoms. Ristocetin has produced thrombocytopenia in patients with renal failure and colistin has shown both neural and renal toxicity under these circumstances. Streptomycin and colistin have been found to have mild nephrotoxic effects. There is no absolute contraindication to the use of these antibiotics when the blood urea nitrogen is elevated, but the usually recommended dosages should be reduced.

Generally speaking, the antibiotics of choice will include penicillin, ampicillin, tetracycline and colistin. Sulfonamides, furadantin and nalidixic acid should not be used in the treatment of *acute* disease. They may, however, be used as suppressive agents in chronic infections. Methenamine salts are also effective in this respect with acidification being required only in infections with urea splitting organisms. Once the urine is sterile, therapy should be continued for about three weeks in acute cases and indefinitely in recurrent disease. Frequent urine cultures should be made thereafter because relapses are common once antibiotics are discontinued.

In general, then, in the absence of a significant diminution in renal function, infectious renal disease in the aged should be treated with the same vigor as in younger patients. However, the physician should be alert to the occurrence of strains of organisms resistant to particular antibiotics. In addition, antibacterial therapy, particularly with broadspectrum antibiotics and/or mixtures of antibacterial agents, may encourage an overgrowth of fungi, the most common of which is Candida albicans. This may be prevented with the additional use of mycostatin or tetrax F.

Immunologic Diseases

This group encompasses primarily glomerulonephritis and renal vasculitis. Although both conditions are related to antigen-antibody reactions, actually they

are very different. As an example, it is dangerous to use steroid therapy in glomerulonephritis but it may sometimes be life-saving in vasculitis.

Glomerulonephritis

Glomerulonephritis in the aged will usually be seen only as a chronic disease or as an acute exacerbation of a chronic disease. Both follow infections with nephritogenic streptococci type 12, type 4, Red Lake and less often type 25. Within 2 weeks following such an infection, there is a rise in antistreptotolysin O titer, though occasionally no rise will occur for 4 or 5 weeks. Studies of various streptococcal infections indicate that this immunologic response is not impaired in the aged.

All recurrences of acute glomerulonephritis must be looked upon as acute exacerbations of a basically chronic disease. Both acute glomerulonephritis and exacerbations of chronic glomerulonephritis begin with non-specific symptoms which vary in each case—headache, fever, oliguria, nausea, vomiting and abdominal pain. The latter two may be so severe that an acute abdomen is simulated. The more specific signs include edema (usually periorbital), smoky or grossly bloody urine (latter is rare), hypertension and proteinuria. The sedimentation rate in glomerulonephritis is always elevated and anemia is the rule. The blood urea nitrogen may rise rapidly. Cerebral edema may cause headache, convulsions, paralyses, aphasia and coma. Water and salt retention may cause congestive failure, particularly since the heart may already be damaged by accompanying arteriosclerotic heart disease and involutionary changes due to age.

At all times it must be realized that the symptoms are not pathognomonic, but may also be encountered in other conditions. Hematuria in an elderly individual should also lead to a search for a urinary tract tumor. The oliguria (or even anuria) and high blood urea nitrogen may even suggest acute tubular necrosis, but none of the common etiologic factors for the latter will be found, e.g., shock, trauma, hemorrhage, incompatible blood transfusion, exposure to carbon tetrachloride or other exogenous poison.

A particular problem exists in relation to subacute bacterial endocarditis. Renal pathology in this disease is, for the most part, typical glomerulonephritis and progressive renal insufficiency may be the predominant clinical picture in the older patient.

The disease may be prevented by adequate treatment of all streptococcal infections. This would amount to one injection of 1,200,000 units benzathine penicillin G. It must be remembered that there are in the United States an abundance of grandparents who maintain close contact with their grandchildren. The exposure to streptococcal infection is therefore maintained well beyond late adult life.

Treatment of glomerulonephritis in the aged differs in no radical way from that in younger persons. However, a word of caution should be given about prolonged bed rest in the elderly who, when immobilized, are more prone to develop osteoporosis, phlebothrombosis and more advanced arthritic changes. In addition, it should be kept in mind that active glomerulonephritis in older people is more likely to be an exacerbation of a chronic process. In active periods, salt should be rather sharply restricted as well as fluids when it is necessary to control edema. Dietary protein restriction and a generous carbohydrate intake may have additional value. Digitalis, antihypertensive agents and diuretics should be used only with clear indications and considerable caution in the older patient with renal disease.

Nephrotic syndrome refers to a group of disease states characterized by proteinuria and the excretion of double refractile bodies in the urine. The diagnosis is often considered established whenever there is persistent excretion of protein in excess of 3.5 gms. per day. There is a variable tendency towards ascites, edema, hypoproteinemia and hyperlipemia. The urinary sediment shows few if any abnormalities. The blood pressure is usually normal, and there is little if any azotemia.

The exact etiologic diagnosis should be established because in many instances this will determine therapy. A subacute or subchronic phase of glomerulonephritis accounts for half the cases and disseminated lupus erythematosus accounts for another 25 percent. For years the nephrotic syndrome may be the only sign of lupus erythematosus, and in such cases LE cells may be frequently difficult to demonstrate. If Kimmelstiel-Wilson's disease (intercapillary glomerulosclerosis) is also included, 90 percent of all the possible causes of nephrotic syndrome have been mentioned.

If intercapillary glomerulosclerosis develops after a long history of diabetes mellitus, there will be no problem in diagnosis. However, sometimes with the onset of this complication, glycosuria as well as blood sugar levels tend to diminish though the 2-hour post-prandial blood sugar may still reveal abnormally high values.

Finally, the Kimmelstiel-Wilson syndrome may be the initial clinical manifestation of diabetes.

The remaining cases of nephrotic syndrome will be manifestations of other collagen diseases, vascular disease, systemic infections, amyloid disease, drug reactions and allergic conditions. Chronic pyelonephritis hardly ever—if ever—leads to nephrosis.

Corticosteroids are only to be used with great caution in glomerulonephritis, and are contraindicated in Kimmelstiel-Wilson's disease because of the adverse effects on sugar metabolism. Almost all adults with nephrotic syndromes ultimately develop renal failure. Progressively falling creatinine clearance heralds the final stage of the disease. General therapy in all cases should include:

1. Bed rest during the early phases;
2. A diet containing at least 50–60 gms. protein daily;
3. Salt restriction as long as edema persists;
4. Antibiotics for intercurrent infection; and
5. Diuretics are often effective but may contribute to chronicity, particularly if they provoke substantial potassium loss.

Vasculitis

Renal disease may also be manifested by an immunologic response in the small vessels of the kidney. This is classically seen in polyarteritis nodosa which is a multisystem disease. In addition to multisystem involvement, hypertension, leucocytosis, and eosinophilia are almost obligatory to the diagnosis. Splenomegaly, polyneuritis, abdominal colic and other gastrointestinal complications are very common. The vascular inflammation involves the kidney more frequently than any other organ even though it is a widespread disorder. Corticosteroids in high doses may be helpful but great caution is indicated when hypertension and renal failure are present.

HYPERTENSIVE AND DEGENERATIVE DISEASE

The effects of involutionary processes and atrophy secondary to atherosclerosis have already been mentioned in the introduction. This section will concern itself with two diseases which hitherto have only been referred to as components of other syndromes—hypertension and diabetes mellitus.

Hypertension

When discovered in the elderly individual, hypertension has often been present for a long time. Under these circumstances, the high blood pressure is generally fixed and will persist to a certain degree even if an underlying cause can be found and corrected. Nevertheless, a cause must be sought because this is the only hope to stabilize the disease and prevent a malignant phase. The clinical laboratory will help in diagnosing pheochromocytoma, Cushing's disease and aldosteronism. The concomitant association of pyelonephritis and hypertension is real but the cause and effect relation is far from established. Though phelonephritis is very common in older people, many of those so afflicted never develop hypertension.

If a true unilateral atrophic pyelonephritis can be demonstrated, then nephrectomy will benefit about 50 percent of the patients in whom the hypertension has not been present for very long. In the older age groups, however, this will be exceptional.

Medical evaluation of hypertension will have greatest practical significance if the elevated blood pressure has been present for less than 3 years. Even if the original cause of the hypertension was a unilateral renal disease, removal of the initially involved kidney might even shorten the patient's life if the opposite kidney has suffered from irreversible vascular changes.

Diabetes Mellitus

There is little, if any, direct evidence linking the severity of diabetes mellitus in terms of sugar metabolism with the development of such complications as vascular disease, neuropathy and retinopathy. In many cases the duration of the diabetes seems to play a role, but even here, any or all of the complications may precede the elevated blood sugar levels. The renal diseases associated with diabetes mellitus include:

1. Nephrosclerosis;
2. Pyelonephritis;
3. Intercapillary glomerulosclerosis (Kimmelstiel-Wilson's Disease);
4. Necrotising renal papillitis.

Pyelonephritis is found in at least 30 percent of all diabetics that come to autopsy. This complication is, therefore, worth considering in all patients, whether they are asymptomatic or in deep uremic coma. Although mentioned in conjunction with the nephrotic syndrome, other features of intercapillary glomerulosclerosis should be pointed out.

The syndrome has two important characteristics in addition to proteinuria:

1. It may be completely asymptomatic, and is occasionally a chance histological finding at autopsy.
2. Blood and urine glucose levels tend to drop as the disease progresses.

A true nephrotic syndrome occurs in only 10 percent of the patients with well-developed intercapillary glomerulosclerosis. The clinical picture may include a moderate albuminuria, hypertension and renal insufficiency. Retinopathy and glomerulosclerosis are frequently found together.

Necrotising renal papillitis is characterized by infarction and necrosis of one or more renal papillae with sloughing of medullary tissue and pyelonephritis. The medullary tissue may sometimes be found in strained urine specimens. It seems to be the result of many factors, foremost of which are infection, vascular disease and obstruction. In this complication, poor control of diabetes may also play a role. Although it is spoken of almost only in conjunction with diabetes, necrotising papillitis has also been seen in uremic states, angiitis and renal vein thrombosis complicated by pyelonephritis, and in some patients with prostatic obstruction. Necrotising papillitis is a serious disease which runs a fulminating course with high fever, severe renal insufficiency, and usually terminates in death. It is best prevented by relieving urinary tract obstruction and vigorously treating all the associated pyelonephritides.

From about 1953 on, a series of reports has appeared pointing out that the prolonged use of preparations containing phenacetin, aspirin and caffeine may result in a syndrome of interstitial nephritis and capillary necrosis. Such preparations are widely used in the elderly for analgesic purposes. Though phenacetin is suspected as the offending agent, the possibility exists that a common contaminant, acetic-4-chloranilid, may be at fault. Because of this possible complication, the long-continued use of this preparation should be avoided. (Editorial J.AMA, 184: 157, 1963.)

RENAL CALCULI

The consideration of renal stones is particularly important in the aged because these calculi may be responsible for either acute or chronic renal syndromes, and if unrecognized, may lead to the loss of one or both kidneys. There is much basic information in this field which is of general importance. Many of the constituents of calculi, particularly calcium, are present normally in the urine as supersaturated solutions and are maintained as such by protective colloids. The mechanism by which precipitation in supersaturated solutions is prevented is very delicate. If either the concentration or the pH changes, precipitation may result. At an alkaline pH, phosphates and carbonates are insoluble; acid pH will favor precipitation of uric acid and cystine. Oxalates precipitate easily even in neutral solutions. Uric acid and calcium oxalate stones grow slowly. Cystine and phosphate stones tend to grow rapidly, filling the cavity in which they have formed, thereby producing the typical staghorn or dendritic calculi of the renal pelvis. Stasis produced by a stone favors its continued growth because of:

1. Changes in concentration;
2. Deterioration of protective colloids;
3. Infection.

Even if the risk is substantial, any obvious obstruction must be corrected. Infection with a urea splitting organism will increase alkalinity and cause precipitation of phosphates, adding these substances to whatever salts the stone may have originally contained. Pyelonephritis may be the presenting and, on occasion, the only sign of a renal calculus. Triple phosphates practically always mean infection with an ammonia splitting organism.

Calcium

A person on a normal American diet will excrete in the urine approximately 200 mg. calcium/day. The identification of calcium as a component of a calculus should give rise immediately to a search for the many causes of hypercalciuria. Most urologists routinely order at least one determination of the serum calcium, phosphorus and alkaline phosphatase on their patients with renal stones. Although a high serum calcium is the most consistent finding in hyperparathyroidism, this may not always be evident. In addition, each physician must be aware of what constitutes normal and high values for his particular laboratory. Laboratory errors are frequent in this determination and no technician can handle large numbers of analyses without sacrificing accuracy. Our search should not end with the exclusion of hyperparathyroidism. Other hypercalciuric syndromes include: thyrotoxicosis, Paget's disease, sarcoidosis, malignancies, hypervitaminosis D., milk-alkali syndrome (Burnett), renal tubular acidosis, berylliosis, and finally the waste basket-idiopathic hypercalciuria.

Two weeks of immobilization, particularly when due to paralyses or a fracture requiring a large body cast, may produce a urinary calcium excretion in excess of 500 mg./day, and thereby, to calcium stone formation. In the aged, this reaction to immobilization is even further exaggerated.

Hypercalciuria without hypercalcemia is particularly frequent in Paget's disease, hyperthyroidism, renal tubular acidosis and idiopathic hypercalciuria. Chronic diarrhea favors the formation of calcium stones without either hypercalcemia or hypercalciuria. In these cases increased urine concentration as the result of dehydration is probably the decisive factor.

Uric Acid

Excessive elimination of uric acid under a variety of conditions also presents favorable situations for formation of urinary track stones. This would most commonly occur in gout and the myeloproliferative disorder.

TUBULAR DISEASES

These diseases are usually congenital and will generally express themselves in early life. Survival of such patients to older age is for the most part unusual, and can only occasionally be achieved by early diagnosis and continued therapy. One example of an acquired tubular disease would be the adult Fanconi syndrome.

In the aged, Fanconi's Syndrome will be seen only as acquired secondary to heavy metal toxicity (cadmium, uranium and lead), Wilson's disease (copper deposits in the tubules), malignancies, sometimes multiple myeloma with Bence Jones proteinuria, rarely in the form of a Vitamin D resistant osteomalacia. It has also been reported following the ingestion of outdated tetracyclines.

Treatment of the primary disease may be helpful. This would include BAL in heavy metal toxicity; penicillamine to remove copper in Wilson's disease; and Melphalen to decrease excretion of Bence Jones protein in multiple myeloma.

RENAL FAILURE

The complete inability of the kidney to excrete the normal load of metabolites produced within the body is designated as renal failure. This should not be confused with renal insufficiency, i.e., inability to perform standard renal function tests. Both acute and chronic forms are known. The acute phase of renal failure usually presents as oliguria, i.e., a daily output of 100–300 ml. In anuria the total output will be less than 100 ml./day. In order to diagnose acute renal failure as rapidly as possible, any output less than 20 ml./hr. should be immediately evaluated.

Acute Renal Failure

The most common etiologic factors in this syndrome are related to a decreased renal blood flow usually secondary to a diminished circulating blood volume. Examples would include shock, transfusion with incompatible blood, other forms of intravascular hemolysis, dehydration and following the clamping of the aorta for the resection of an aneurysm. In all these situations, renal blood flow will be compromised usually to guarantee flow in the coronary arteries and circle of Willis at the base of the brain. Although there is a tachycardia, blood pressure will be maintained until the depletion of the blood volume has become serious. The urine output is therefore a much better guide than the sphygmomanometer in obtaining inferential evidence about the state of blood supply to the kidney.

A more complicated problem is presented by renal failure following a crushing injury. In this condition the effects of depressed circulating blood volume due to shock are combined with tubular toxicity and epithelial degeneration caused by reabsorbed muscle pigments. Other examples of acute renal failure in the aged include hepatorenal syndromes (seen in severe liver disease), acute exacerbations of chronic renal disease, cortical necrosis following shock, and bilateral obstructive uropathy.

Pre-existing renal disease will add to the complexity of the diagnostic and therapeutic problems. The general condition of the kidneys at the time of the acute insult will be a major factor in determining the amount of ensuing renal damage. Administration of proper treatment requires that the cause of the renal failure should be determined as soon as possible. For this purpose, the essential characteristics of the main groups need be considered: prerenal failure, nephrotoxic tubular damage and obstructive uropathy or postrenal failure. It must be remembered that in at least one-third of the cases of acute renal failure, no single etiologic agent can be incriminated.

Prerenal Failure

Prerenal failure is a consequence of diminished renal blood flow usually resulting from a decreased circulating blood volume, e.g., trauma, hemorrhage, burns or diarrhea. The body, in order to maintain its circulation and vascular integrity, secretes large

amounts of aldosterone and antidiuretic hormone. Aldosterone causes salt retention and secondarily water retention. Antidiuretic hormone produces water retention by increasing its reabsorption in the tubules. Diagnosis will therefore be based on:

1. A history suggesting that a diminished circulating blood volume was or is present.
2. Oliguria—urinary output less than 20 ml./hour.
3. Markedly diminished urinary sodium concentration—less than 10 mEa/liter—as the result of aldosterone effect and decreased glomerular filtration rate.
4. Increased concentration of urine—specific gravity above 1.020—as the result of antidiuretic hormone effect.
5. Moderate blood urea nitrogen elevation with normal creatinine levels. The serum creatinine tends to remain normal until nephrotoxic tubular damage develops.

Although the textbook picture is clear-cut and easy to understand, rather frequently the clinical diagnosis is only a calculated guess. A marked depression of circulating blood volume, for example, would depress glomerular filtration rate to such a degree that the concentration mechanisms must suffer even under maximum antidiuretic hormone stimulation. The depressed tubular concentration ability of the aged has already been commented upon in the introduction. Low specific gravity, therefore, would not rule out prerenal failure in elderly people.

Prerenal failure, if not rapidly treated, will go imperceptibly over into true parenchymal damage. In most cases, however, restoration of blood pressure, blood volume and cardiac output will quickly establish urine flow again. On the other hand, it must be kept in mind that a large fluid load might be injurious to an elderly patient who could not excrete it.

Nephrotoxic Tubular Damage

Abundant fluid administration does not constitute the basis of therapy in all forms of acute renal failure. In parenchymatous renal failure, fluids must be restricted. This type of failure may be due either to prolonged renal ischemia as the result of uncorrected prerenal factors or to nephrotoxic tubular damage from heavy metals, carbon tetrachloride or drugs. Theoretically, acute exacerbations of such chronic diseases as glomerulonephritis and pyelonephritis should be included, because in this group when oliguria develops, therapy is the same as in acute tubular necrosis.

The course of parenchymatous renal failure may be divided into three phases which are not completely distinct but merge one with the other. Their approximate identification, however, is necessary in order to determine the proper therapeutic regimen.

Oliguric or Anuric Phase

This may last anywhere from one day to several weeks. During this phase the blood urea nitrogen will rise 10–40 mg%/day, depending on the degree of catabolism and protein intake. Other findings are variable but include elevated serum potassium, phosphorus and magnesium; depressed serum CO_2 and calcium. Serum sodium and chloride may be decreased due to dilution. In addition, there is a shift of sodium from the body fluids into the cellular spaces.

Potassium is the important limiting factor as far as survival is concerned, because at a serum concentration of 10 mEq/L, there is a cessation of cardiac function. The elevated serum potassium is the result of catabolism (release of potassium from destroyed cells), acidosis and renal retention. The best means of temporarily combating the effects of hyperkalemia is to give 20–40 mEq of $NaHCO_3$ in a 10-minute period, watching carefully for signs of tetany. This bicarbonate corrects acidosis and supplies the antagonistic ion, sodium. It is superior to the occasionally recommended glucose and insulin therapy. The latter merely shifts potassium from the extracellular to the intracellular compartments, but the effect is at best transient. More permanent results can only be achieved by dialysis.

Water replacement should be extremely conservative. Overhydration, especially in the aged, has been a frequent cause of rapid deterioration, adding the problems of congestive failure and cerebral edema to those of uremia. The figure of 1000 ml. as automatic replacement for insensible fluid loss cannot apply in renal shutdown. The catabolisms of fat, carbohydrate and protein produces significant amounts of endogenous metabolic water. We can therefore only be guided by daily weights in judging fluid replacement. While anuric, the patient should lose 0.3–0.4 kg./day. This will generally allow for an intake of no more than 400 ml. water/day in addition to what is required to cover urine loss, diarrhea and vomitus. In this way, the patient is protected from a circulatory overload. The fluid supply should, whenever possible, be given orally and should have caloric value. Many clinicians still feel that the testosterone derivatives (so-called anabolic agents) are useful in reversing the catabolic processes

that occur in the anuric phase. These may be cautiously administered at doses equivalent to 50 mg. testosterone propionate daily. The patients should be observed carefully for signs of hepatic toxicity and sodium retention.

All necessary medications such as digitalis, dilantin and antibiotics should be given at reduced doses to avoid cumulative toxic effects from retention. Anemia when present is refractory to all hematinics. Nevertheless, transfusions should only be given to correct depressed blood volume. These should be administered as fresh packed cells in order to avoid potassium and fluid overload.

Early Diuretic Phase

As the kidney recovers, urine output may gradually or rather abruptly increase. Salt loss may be excessive in this stage and careful measurement of 24–hour urine sodium must be made in order to calculate amounts necessary for replacement.

Convalescent Phrase

The patient gradually returns to a normal state during which a chronic low grade azotemia may persist although this is rare.

Obstructive Uropathy or Postrenal Failure

Total anuria is most frequently seen in obstructive uropathy. In both prerenal failure and nephrotoxic tubular disease, oliguria is the rule. Simultaneous obstruction of both ureters is certainly rare but it must always be considered because it is remediable when correctly treated. It could result from a massive excretion of calcium, uric acid or sulfonamide crystals with obstruction in the renal pelves and ureters.

In order to correctly diagnose this condition, a flat plate of the abdomen should be made. If the kidneys are of normal size or enlarged, one ureter should be catheterized to the renal pelvis. If no urine is obtained, then obstruction is ruled out. These patients however are never anuric. If urine is obtained from one kidney, the other should also be catheterized and both intubations left in place until a normal output is guaranteed.

In obstructive disease, rapid decompression is dangerous, particularly in the aged. It may be followed by sudden deterioration of renal function as well as fluid and electrolyte abnormalities. There is usually a substantial diuresis accompanied by massive indiscriminate electrolyte loss. This is due to tubular damage which developed during the period of obstruction.

Chronic Renal Failure

This is the end state of all renal disease that does not heal completely. It may exist in a form compatible with normal life for many years. On the other hand, it may be slowly progressive, blending imperceptibly with the late phases of the acute illness. Sometimes the chronic disease is rather stable but punctuated by acute exacerbations of the original illness. This is frequent in glomerulonephritis and pyelonephritis.

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COMMON LOWER URINARY TRACT PROBLEMS IN OLDER PERSONS

By

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INTRODUCTION

Total care of the elderly includes the maintenance of maximum activity, emotional security and physical comfort. Certainly, much can be offered by medical practitioners towards the relief of debilitating somatic and social distresses of the elderly presented by the commonplace diseases of the lower urinary tract. There are no greater forms of personal human tragedy than the disorders of urinary control and sexual performance. Too often, these losses are equated with and relegated to the "ravages of old age" and are denied the careful inspection and investigation so readily available to the young.

CLINICAL FEATURES

The clinical features of lower urinary tract disease in the aged generally fall into two categories. The most dramatic and obvious types, typified by hematuria, fever and acute retention, are undeniable. The relatively silent insidious ones, such as a change in voiding patterns, are easily overlooked. One must be attuned to minimal manifestations of new illness, especially so in the face of coexisting organic and functional disorders. This is as true as in the gastrointestinal tract in the elderly, where any change from the normal daily toilet habits of the individual is significant. Gradual but relentless progression is the rule in untreated lower urinary tract illness.

Urinary tract infection is second only to pulmonary disease as the most frequent cause of febrile episodes past age 65. As will be discussed, the etiology of incontinence is a complex interaction of neurologic, bacteriologic, myopathic and anatomic defects. The careful delineation of true causation points the way to therapeutic triumph and reinstatement into an acceptable social pattern.

Other features of lower tract disease include: those of the irritated outlet such as urgency, frequency, nocturia and dysuria; urinary retention; and ill-defined pain referable to the low back, perineum, pelvis, groin, abdomen or flank. Any change in the state of alertness should be a clue to this area. In the course of "routine" evaluations, an incidental physical or laboratory finding may cast suspicion on the urinary tract.

PHYSIOLOGIC AND ANATOMIC CONSIDERATIONS

The voiding mechanism is a complex interaction of voluntary and involuntary processes. A delicate balance exists between the detrusor (bladder muscle) and the outlet. Changes from any cause which diminish efficiency of the motor component or increase resistance in the outflow tract result in incomplete emptying. A weak detrusor, as expected with loss of muscle tone in the aging process, may turn a "normal" outlet towards an obstructed one. Any suspicion of infection and/or incontinence must cause consideration of residual urine volume. The causes include:

1. Simple unrecognized obstruction;
2. Combination of obstructive and neurogenic factors;
3. Neurologic dysfunction;
4. Pure myopathic states;
5. Iatrogenic causes; usually injudicious use of drugs as probanthine and anticholinergic preparations.

Just as the heart muscle obeys "Starling's Law," so does the bladder. Gradual distention of the bladder produces spasmodic contractions with compensation, until the point of the "kicking off" contraction is reached. Overdistention of the bladder, usually under chronic conditions, may produce complete decompensation with overstretched muscle fibers unable to reach a point of efficient coordinated contraction. Often, relief of retention can allow for resetting of compensating mechanisms. As in heart failure, judicious drug therapy can be used to increase bladder efficiency.

Sufficient evidence exists to incriminate senescent female hormonal changes in the decreased resistance of the urethral and bladder epithelium to injury, infection and metaplasia. "Atrophic urethritis" connotes the component of an altered epithelium with loss of distensability coexistent with invasion of the ubiquitous perineal pathogens along the entire urethral length. Suppuration and a narrowed channel lead to progressive destruction of previously healthy or compensated

urethral supports. Further constriction of the lumen produces a true stricture.

Consideration of the sequelae of *urinary incontinence in the female* can yield an understanding of some of the initiating components of chronic genitourinary infections. Urine commonly collects in the vagina especially among the bedridden. Vaginitis and endocervicitis ensue from the stagnant vaginal pool. In those persons with sufficiently relaxed supports to produce a posteriorly displaced urethral meatus, one deals with an essentially intravaginal outlet. The balance of tissue resistance versus normal flora and low-dose innoculum is destroyed and the heavy pathogen load produces urethrotrigonitis. Irritation of the detrusor and narrowing of the outlet is a potent combination and incontinence ensues.

The practicing physician commonly follows the cycle of events only in its separate components. We have been called to see isolated occurrences of supposedly simple etiologies, where in fact the natural history of the process can yield severe illness. An example is the common phenomenon of the self-traumatized elderly female who is first brought to the attention of the physician because of bloodstains noted on bedclothes or underwear. The meatitis so produced inevitably progresses to meatal stenosis. From this discussion, one can understand the necessity of eliminating causes and readjusting natural defense mechanisms rather than yielding to the deadly euphemism—"symptomatic therapy."

The primary offender in *disorders of micturition in the male* is, of course, the prostate. Prostatic enlargement is an unrelenting process initiating with puberty. The rate and type of enlargement varies, but most authorities agree that both factors are essentially unrelated to sex habits and past sexual performance of the individual. Some degree of prostatism (outlet symptoms) is present in three-fourths of the males 65 and over. The usual bread-winning American male tends to defer medical attention until the issue is forced by the onset of hematuria, infection symptoms or acute retention. Prostatic carcinoma has an incidence of 20 percent in autopsies of males over 60 years of age.

CLINICAL EVALUATION

The G.U. tract is most amenable to pointing up the value of a good history. In the vast majority of instances, the problem focus can be resolved without resorting to laboratory examinations. Most important is the type of onset of the symptoms, their duration, relation to activity, diurnal differences, stream patterns and the voiding habit. An exploration of emotional and social factors can be both diagnostic and therapeutic; especially so when the spouse is present. Of course, a thorough system review is mandatory with particular attention to commonly related disorders including diabetes mellitus, cerebrovascular problems, glomerulonephritis, venereal disease and neurologic disorders.

The physical examination must emphasize fundoscopy, neurologic examination and abdominal palpation and percussion. Pelvic-rectal examination must be performed despite severe emotional states and/or physical disabilities.

For the effort, no yield of information is as abundant as examination of a fresh, clean-voided urine. Midstream, clean-catch urine cultures are important as regards initiation and continuation of specific therapy. Other laboratory tests include blood counts, blood sugar, urea nitrogen, acid and alkaline phosphatase, calcium, phosphorous and uric acid. It has been shown that the acid phosphatase can rise and remain elevated for several hours following digital prostatic palpation, but the incidence is low in benign disease and only moderate in presence of malignancy.

Radiologic tests must be used with selectivity. An excellent screening procedure is the IVP with post-voiding film. However, it can be modified with ease to obtain the maximum information. It is a function test as well as an anatomic delineator. Uremia does not preclude urography and with triple dose or infusion studies, excretion can be seen with blood urea nitrogen levels to 120 mgm% and creatinine clearances as low as 10–15 cc/min. High-dose studies can yield sufficient filling of the bladder with contrast material so that antegrade voiding cystourethrography can be performed, thus eliminating the need for catheterization and retrograde studies. Of course, vesicoureteral reflux cannot be observed by this method. One recent study revealed reflux to be present in 10 percent of cystograms performed on adults, excluding paraplegics.

Nephrotomography with high-dose or infusion studies is a valuable adjunct to differentiation of renal mass lesions. X-ray measurement of residual urine volume is generally inaccurate, but can be helpful in those cases where no residual is seen or conversely where massive retention is noted, especially when div-

erticuli are present. Incidental inspection of bony structures and gaseous viscera is an added dividend of these studies.

Often, a gentle, aseptic, nontraumatic catheterization with a soft rubber catheter can yield information as to presence of obstruction, site of obstruction, residual urine and the obtaining of a reliable urine culture. Indeed the catheterization can be therapeutic as well as diagnostic.

Cystoscopy can be performed under local anesthesia in both sexes and should be combined with check for residual urine, Marshall test, urethral calibration and/or bladder irrigations. The procedure is always indicated in the presence of hematuria, even if the cause is suspected. Retrograde pyelography can be beneficial in the differentiation of renal masses, ureteral obstructions and distortions, and ureteropelvic urodynamics.

Cystometrogram, in the best of hands, is a crude test and reliable only after repeated corroborations. Its use in differential diagnosis is best when the extreme patterns are noted. However, it can be an important predictor of the return of detrusor function postoperative and should be used as a baseline determination when adjunctive cholinergic therapy will be used.

Tissue diagnosis is always sought and the routes available to the urologist range from bladder and urethral biopsy to percutaneous renal needle biopsy or cyst aspiration and to the many methods of prostatic biopsy. Perineal, transrectal, open perineal and transurethral prostatic biopsy all have their particular protagonists. But all agree on the individuality of any particular patient and the need to fit the procedure to the problem at hand. Most needle biopsy methods offer minimal discomfort but the equivocal yield can lead to multiple biopsy attempts. In the presence of obstruction, a transurethral resection specimen is more reliable and definitive even though the carcinoma originated in the inferior lobe of the prostate.

Vena cavography, selective arteriography and aortography are hazardous procedures in the elderly and must be completely individualized.

It must be noted that minor urologic surgery should be performed by the general practitioner with caution and never before complete prior evaluation. All cases of hematuria, even where the etiology is supposedly known, e.g., coumadin, should be referred to a urologist. Catheterization by the uninitiated can be perilous and should probably be performed in a supervised setting.

SPECIFIC DISEASE STATES

Lower Urinary Tract Infection

Lower urinary tract infection is one of the commonest misfortunes of the elderly and, although not fatal, causes infinite distress. Complicating the etiologic picture is the fact that most of the aged have had some type of prior urethrovesical manipulation. Separating the de novo problems from the chronic, and even the iatrogenic, can be difficult. It always is best to consider the disease of this area in simple anatomic terms, even to the categorization of "outside-to-inside."

Male problems can reside in the prepuce, glans, urethra, prostate and bladder with such matched entities as posthesis, phimosis, paraphimosis, balanitis, urethritis, prostate enlargements, prostatitis in all its stages, and the atonic decompensated bladder.

Female problems can include prolapsed urethral mucosa, meatitis, distal urethral stenosis, urethral diverticulum, bladder neck with or without pseudopolyps, interstitial cystitis, Hunner's ulcer, postradiation, cystocele, contracted bladder, and genital prolapse.

Similarity of the sexes is often evident because of equal existence of certain entities despite anatomical variations. Both sexes can suffer from meatal stenosis, urethral stricture, urethral and bladder neoplasms, bladder neck contracture, diverticuli, calculi, reflux, ectopia, foreign body, neurogenic dysfunctions, and the effects of prolonged recumbency.

The principles of treatment are directed towards adequate drainage and chemotherapy. Specific chemotherapy, when possible, is the ideal. Chronic infections should be treated by suppressive therapy only after complete urologic evaluation. When present, residual urine must either be eliminated or reduced. No amount of antibiotics can permanently cleanse a stagnant pool. In selected cases, short-term drainage will be effective in rehabilitating the detrusor, controlling sepsis and increasing patient mobility.

Unfortunate patients who are committed to long-term catheter drainage are necessarily burdened with the consequences of that foreign body: chronic bladder infection, chronic urethritis, bladder spasm, bladder debris, catheter management and the economics of the medical supervision. Experience has shown that almost everyone who has been on catheter drainage for six months stays on for a lifetime. Analysis of all age groups maintained on catheters, for whatever cause, reveals a median lifespan of five years from the time

of the original insertion. Certainly, the lifespan is shorter in the aged.

Urinary Incontinence

The problem of inappropriate urine loss can consist of pure and mixed components of neurogenic, urgency, stress and overflow incontinence.

1. *Neurogenic incontinence* can be subtle or dramatic in onset. Micturition is a reflex act complicated by antagonistic action from sympathetic and parasympathetic nerve supply to both the bladder muscle and the outlet sphincter. Sympathetic stimulation inhibits the detrusor and constricts the sphincter. Parasympathetic action contracts the detrusor and inhibits the sphincter. In addition, voluntary fibers run to the external sphincter and associated perineal musculature. Bladder sensory fibers to the sacral center complete the nerve arc and initiate involuntary responses, as seen in suprasacral cord lesions, or voluntary responses via the cortical efferent pathways. A consideration of specific disease entities will clarify the basic mechanisms. One must remember that in the elderly, as already stated, a "pure" lesion is unlikely and the imposition of other factors can alter an otherwise compensated situation.

Tabes dorsalis is a loss of the sensory portion of the reflex arc. The residual urine volume is increased and overflow incontinence, especially at night, is noted. Remarkably enlarged, painless, atonic bladders are found to be smooth walled, without trabeculation. Treatment is directed toward reducing the residual urine volume by decreasing outlet resistance through transurethral resection, additional emptying through use of the Crede maneuver, and specifying a timed voiding pattern.

Diabetic neuropathy can best be thought of as "pseudo tabes" because the sensory disturbance is patchy and a motor loss may also be present. It is usually directly related to the duration of the diabetes, but occasionally the initial symptom of diabetes may be bladder dysfunction. Straining to void, dribbling and incomplete emptying are usual symptoms, but when infection is present, the irritative complaints predominate. Treatment is essentially the same as for true tabes, but repeated resections may be necessary until the residual urine volume becomes manageable.

Cerebral cortex lesions are most common in the elderly and represent a disruption of cortico-efferent pathways. Voluntary control varies with the extent of the lesion, but essentially the bladder becomes autonomous under direction of the sacral segments. The physician must be on guard to distinguish acute losses from the postacute stages. Examination of a paretic extremity is quite simple and the recovery process easily visible. However, we must apply the same close inspection to bladder and sphincter recovery following cerebral accidents if we are to offer counsel. Associated complaints are urgency, frequency and urgency incontinence.

Treatment efforts are directed towards retraining, preventing infection and increasing motivation. The outlet, from meatus to bladder neck, must be kept open and ambulation is imperative. Cholinergic drugs have a real place in therapy with individualized dose schedules. Retraining by catheter or timed voiding patterns should be attempted.

Parkinson's disease has no specific vesical dysfunction, but again one deals with probable additive factors. Most drugs used for control of the extremity problems are sympathomimetic and exaggerate the obstructive lower urinary tract lesions. Treatment cannot be instituted before a thorough urologic evaluation.

Pernicious anemia represents a combined motor and sensory lesion. *Myasthenia gravis* is an isolated motor disturbance. *Hypothyroidism* can be unsuspected in the elderly with more gross disabilities, but is not uncommon and represents a myopathic state secondary to reflex conduction delays. *Anoxemia* and *electrolyte imbalance* display the same characteristics as cortical lesions, with loss of inhibition.

2. *Urgency incontinence* always depends on local mechanisms, but may not be noted until the irritative focus develops secondary to supra or extravesical disease. Examples are diverticulitis, pelvic tumors, vaginitis and endocervicitis. More usual causes are urinary tract infection, bladder tumor, bladder stone, prostatic enlargement and urethrovesical relaxations with residual infected urine.

3. *Stress incontinence* is a variable entity dependent on psychosocial pressures as well as bladder pressures. What is tolerable or conversely distressing to one person may not be so to another. In women, it is commonly attributed to a cystocele with large residual static urine; infection is usually present. Uterine prolapse is another cause and is often remedial regardless of age, but one must judge the expected benefit against morbidity of the operation. A pessary used judiciously and with controlled supervision is helpful in the temporizing situation. In selected cases, up to 80 percent can be improved by conscientious Kegel exercises,

double voiding and anti-spasmodics. A Marshall test in both standing and recumbent positions is mandatory as part of total evaluation. True stress incontinence in the male, usually is derived from manipulation procedures.

4. *Overflow incontinence* is caused either by obstructive lesions or inadvertent drug therapy. One must acquaint himself with those drugs which tend to be sympathomimetic, e.g., phenothiazines, bromides, muscle relaxants, cough preparations, antispasmodics, anticholinergics, quinidine and sedatives.

Many urologists subscribe to the idea that the most practical approach to the differential between neurogenic and obstructive disease is by transurethral resection, since it is the treatment of choice in either case. We must be wary of the later postoperative or postmanipulative obstructions. The commonest post transurethral resection complication is submeatal stenosis, which can be treated by meatotomy and/or home dilatations with a short bougie.

Acute Urinary Retention

Acute retention is most often a dramatic, undeniable event which is potentially life-threatening. However, it is not unusual to observe minimal prodromal complaints or to hear none from the disabled patient. The occurrence progresses to renal failure if unattended, and if managed rather than treated, results in cardiovascular and cerebrovascular embarrassment. No medicinal agent has as yet been found to alleviate obstruction, but many preparations can precipitate retention, as previously noted.

Practitioners are justly wary of surgical intervention in the elderly with attendant risks of blood loss, metabolic imbalance, sepsis and anesthetic problems. However, sufficient experience by competent urologists has made transurethral surgery considerably more applicable to the aged population than open surgery. Whereas open prostatectomy has a low mortality rate of 2 to 4 percent, transurethral surgery mortality is 1.3 percent. The urologist is best able to judge which procedure, if any, fits the particular set of circumstances. Even a staged resection is more desirable than a life-shortening commitment to the indwelling catheter.

Prostatism

Early symptoms of prostatic hypertrophy are hesitancy, diminution in force of the stream, frequency and nocturia. Later in the inexorable course, obstructive symptoms such as postmicturition dribbling, poor control, overflow incontinence, the irritated outlet and frank sepsis will appear. A well-known axiom is that hematuria of prostatic origin is more commonly from benign rather than malignant growths. Rarely, renal insufficiency is the first evidence of the disease process.

The degree of obstruction, as seen particularly with median bar formation, is not necessarily consistent with the overall gland size measured by rectal examination. Similarly, there may be little or no correlation between the size of the residual urine volume and the degree of obstruction. A chronically infected bladder may often have markedly decreased capacity, even though the initiating process was outlet obstruction with retention. Careful study has revealed a significant incidence of vesicoureteral reflux associated with prostatic obstruction, especially with infection.

Accurate diagnosis and treatment plan depends upon radiographic, laboratory and cystoscopic assay. The basic components of treatment are complete appraisal and good judgment, careful preoperative preparation, selectivity of the procedure, and good postoperative care. If uremia has been noted, prolonged drainage may be necessary, possibly via a suprapubic cystostomy. Electrolyte balance, specific antibiotics, hydration and cardiovascular compensation must be obtained preparatory to surgery. Often a mannitol induced diuresis is helpful during and after the procedure. Dilutional hyponatremia may be evidenced postoperatively, but is readily managed. Positive pressure ventilation and early ambulation are standard postoperative measures in geriatric surgery.

It must be categorically stated that transurethral surgery does not cause impotence. Many patients accept the old wives' tale of demasculinazation and so need firm assurance, even if not requested. On the other hand, many would like a magical postoperative rejuvenation of sexual performance, where the presurgical situation has been disappointing. Although it is not possible to offer this feat, patients can be advised that exacerbations of sexual performance are related to general health status and removal of the offending organ produces general rehabilitation.

Prostatic Carcinoma

Stony hard glands or isolated nodules are easily recognizable by the practitioner who completes his physical examination with gloved, well-lubricated index finger. Because prostatic carcinoma originates in the inferior lobe and because of the relatively high incidence in the elderly male, there can be no excuse

for omission of the rectal examination. The lesion may be entirely asymptomatic, even with bony metastases. Generally, tumor virulence is inversely proportional to the age. The tumor may be localized in the parenchyma for many years. Serum acid phosphatase may not always be elevated in cancer which has extended beyond the capsule. Ilium bone marrow aspiration is a good screening test for metastatic disease, as is the bone survey and IVP.

Treatment consideration in the elderly may not be towards eradication of the tumor, but for relief of obstruction, pain and debility. Radical surgery must be a highly selective decision with complete explanation of the attendant morbidity. Estrogen hormones, castration and cobalt therapy should be chosen with regard to rate of tumor growth, psychosocial phenomena, patient tolerance and stage of disease.

A recent combined study of treatment modes has incriminated estrogens in the exacerbation of preexisting cardiovascular and thromboembolic states. Possibly lower than usually recommended doses might not carry as great a risk as noted in that study. Intravenous stilphosterol or radioactive P_2 may be helpful in refractive cases. Evidence of "occult" tumor as an incidental finding in TUR chips may represent definitive therapy in some cases and may require only yearly palpation for followup.

Bladder Cancer

Symptoms are usually dramatic and include gross hematuria, frequency, dysuria and tenesmus. The tumor is usually multifocal and in certain instances may arise as metastasis from a primary papilloma of the renal pelvis. Tumor virulence is highly variable and close followup is required. Grade 1 lesions are readily treated by transurethral fulguration, however future recurrences may be similarly low grade or progressively more undifferentiated. In the elderly, transurethral resection should be performed if possible and for as long as possible. In the "good risk" patient, one may occasionally consider radical cystectomy, bearing in mind the overall 5 to 10 percent mortality risk.

Treatment of massive hemorrhage may involve hypogastric artery ligation, radiation and/or urinary diversion, even when the tumor is inoperable. The type of diversion must be tailored to the clinical situation and may be ureterosigmoidostomy, ileal conduit, cutaneous ureterostomy, or nephrostomy. According to Grabstald, "the surgeon who opens the bladder to 'get a better look' is not familiar with the problems." The "best look" is usually via cystoscopy, which offers magnification.

Bladder Diverticulum

Diverticuli are common in longstanding obstruction from any cause. They are frequently multiple and may be the focus of persistent infection. Occasional tumors may reside undetected within the hidden depths.

Treatment modes must be directed towards the entire outlet problem. In general, narrow-necked lesions will require some type of surgery, even transurethral enlargement of the neck. Open prostatectomy combined with diverticulectomy is chosen with regard to general health of the patient. Wide-necked lesions generally respond to antibiotic therapy if the outflow tract is patent. We must remember that the bladder stigmata of obstruction will not disappear upon removal of the cause.

Carcinoma of Penis

Sad experience has shown how often examination of the disabled has *not* included the genitalia. This is regrettable. Local irritations, phimosis, paraphimosis, herpetic lesions and meatal papillomas are readily noted and cured. But an ulcerated or fungating glanular or preputial lesion must be biopsied for adequate diagnosis.

Treatment of carcinoma is penile amputation, either partial or total. If radical node dissection is considered in the younger good risk patient, a two-week delay is required to allow inflammation and inguinal nodes to subside.

Testicular Tumors

Testicular neoplasia are primarily a disease of the young adult. Bilateral testicular tumor in the elderly is usually malignant lymphoma and is readily treatable by radiation. Seminoma is usually "spermatocytic seminoma" which has an onset much later in life than the classical type.

Treatment is high ligation of the cord and radiation. Suspicion of tumor is an indication for exploration, not only for diagnostic purposes but for psychological relief of the patient. However, most scrotal masses in the aged are entirely benign processes and include hydrocele, spermatocele, varicocele and hernia. Here again, definitive therapy is straight forward and, if clinically indicated, should be carried out without regard to age, per se, but to general health status.

Impotence in the Elderly Male

Inadequate erection of the penis may be related to infectious disease, nutritional status or vascular insufficiency, but is predominantly due to emotional and situational difficulties. A general rule is that the personality that has enjoyed satisfactory sexual activity in middle life will continue his enjoyment and performance in later years regardless of chronological age. Often, the health status of his sex partner may preclude vigorous pursuits of prior activities, but need not be terminated. We tend to regard the disabled as totally unarousable or not to be in need of sexual activity. Psychologic interviews have shown this belief to be false, and the usual approach to the sexual unit, in which one member has a chronic disease is generally "Victorian". Tragically, medical advisability on coital patterns is rarely sought and more rarely available.

We are hindered by a social pattern and archaic mores that deprecates sexual activity in the aged. The loss of a spouse is taken to mean loss of further coital activity. There is a social inacceptability of the need to seek out a compatible partner. The aggressive widower has an aura of perversity. He suffers anxiety over satisfying basic needs and in fitting into the stereotyped passive role.

Treatment of sex problems must be directed towards "ventilation"—oral catharsis. The patient must be firmly and repeatedly reassured as to physical and mental health. Many "old men" need redefinition of what is masculine performance and what the partner expects or does not expect from their relationship. Before considering transurethral surgery or genital manipulation, we must clearly state that impotence is not a sequel to such measures.

Basic health patterns of good nutrition, rest and activity must be detailed and not taken for granted. Often, placebo therapy has a place in treatment of selected cases. Androgens, thyroid and analeptics are dangerous drugs and, if considered, must be used with extreme caution. Ataraxics may reset the balance of emotional adjustment. The use of penile prostheses should be aired with the patient who is distraught over his inability to satisfy his partner. The physician is required to reassure his patient about the "healthfulness" of an aggressive approach to social and sexual intercourse.

Certain aspects of sex counselling require emphasis because of the ubiquity of old wives' tales and covert self-medication. Alcohol can be a mood elevator, but definitely diminishes sexual performance. Many proprietary drugs, mood elevators and appetite stimulants have heavy alcohol contents. In a considerate attempt to help the distraught partner "get a hold" of himself, the result may be compounding of a physiologic abnormality. In moderate quantities, alcohol can be used as a sedative, thus assuring adequate rest and recuperation.

Anabolic agents may decrease libido, but have use in therapeutic trials. Ataraxics generally decrease libido, but may readjust social situations in which performance would otherwise be impossible. Vasodilators are to be condemned for use in impotence as they are known to shift available blood volume to other than the genitalia. Impotent elderly males are markedly susceptible to quack medications and diverse therapies passed by word of mouth or in the back of shoddy magazines. The medical community must expose these practices for what they are—useless and potentially disastrous. The consequences of overdosage with some preparation containing analeptics—strychnine—can be irreversible and even fatal.

SUMMARY AND CONCLUSIONS

Symptomatology in disease states of the lower urinary tract is extremely variable. The astute, experienced physician can readily deduce a simple diagnostic differential from minimal historical and physical clues. An anatomic approach to diagnosis is most helpful and can expedite the type of tests to be employed. Patients should be referred for urologic evaluation once the symptom level interferes with the normal daily routine. Certainly, any suspicion of diminished renal function, malignancy or hematuria warrants thorough investigation.

Problems of sexual performance constitute a large segment of the anxiety states of the elderly. Physicians must be aware of the need to ventilate these problems and of the extreme relief provided by firm reassurance and sincere interest in the patient's total well-being.

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GERIATRIC GYNECOLOGY

By

Stanley J. Birnbaum, M.D.

The problems of the geriatric patient are of unique concern to the gynecologist. The female genital area, as perhaps no other, reflects the changes of the aging process and is subject to the degenerative and neoplastic disorders typical of senescence. An increasing number of aged females are presenting themselves for gynecological care. There are several reasons for this besides the obvious fact that more of our population is reaching old age. New techniques of surgery and anesthesia have allowed the gynecologist to expand his therapeutic horizons and not consider age alone as a contraindication to essential curative surgery. Older patients also have a reasonable chance for continued long-term survival, and these women are no longer reluctant to have elective surgery performed, so that they can live out these years comfortably and usefully.

Because we now can offer the geriatric patient an expanded therapeutic armamentarium, periodic gynecologic history and examination becomes mandatory to minimize the factor of neglect which is so common in this age group. Gynecologic examination must always be preceded by a careful breast and abdominal survey. At the time of pelvic examination, "Pap" smears should be taken and the cervix and vagina visualized with a narrow bladed speculum. The examination is concluded by a combined rectovaginal examination with palpation of the pouch of Douglas. Other methods of examination, such as sounding the uterus, traction on the cervix, biopsy of the cervix or endometrium, proctoscopy and urinanalysis are frequently indicated. In general, any evidence on gynecologic examination of a mass, bleeding, or ulceration in this age group makes further study mandatory.

VULVA

The skin changes due to aging are most prominent on the vulva, since this area was under hormonal control in the past. There is a loss of hair and subcutaneous fat. The labial folds flatten and tend to disappear into the surrounding skin. The skin itself becomes atrophic—appearing thin, shiny and avascular. The introitus may appear smaller and admit only one finger. When examining the vulva, note carefully the condition of the clitoris and palpate the area of Bartholin's glands. The urethral meatus should also be inspected as well as the anal orifice, noting any hemorrhoidal tabs or fissures.

Inflammatory States

As the endogenous estrogen level diminishes, the vulvar area becomes more susceptible to inflammation and infection. In addition, older women may pay less attention to nutritional needs and local hygienic requirements. The vulvar skin frequently macerates and fissures—especially in the obese patient. The patient's response to the pruritis and burning of vulvitis by scratching, produces more trauma and introduces more infection. The product of all this is known as atrophic and hypertrophic vulvitis—grouped together as "senile" vulvitis. Thus, areas of inflamed shrinkage coexist with thickened, indurated, and lichenified areas. So-called "Leukoplakia" may be noted, the importance of which will be discussed later.

The management of vulvar dermatitis is quite complex, since the etiology is often obscure and secondary infection and over-treatment are common. Before treatment is started, specific underlying causes should be ruled out. These include dermatologic lesions such as lichen planus, neurodermatitis, contact dermatitis, lichen sclerosis vel atrophicus, and drug eruptions. The vulva may mirror systemic disease, especially diabetes mellitus, and a urine specimen and blood sugar determination should be routine in these cases. Pernicious anemia, leukemia and hepatitis can also produce vulvar lesions with pruritis. Culture of all vulvar lesions for monilia and bacteria is essential.

In general, treatment should be gentle and consist mainly of cleanliness, nutritional supplementation, sedation, and soothing local applications. The importance of keeping the area cool and dry must be stressed. During the acute phase, starch water sitz baths (1 cup to tub of warm water), saline compresses, and potassium permanganate soaks (1:5000) are useful in alleviating pruritis and burning and correcting secondary infection. After toilet and bath, the area should be patted dry with soft tissue and dried with a hair dryer or fan. A bland starch powder may be applied. Any malnutrition, vitamin deficiency or anemia should be corrected. Clean, dry, loose-fitting cotton undercloth-

ing should be worn. Following subsidence of the acute phase, the area can be treated with topical applications of soothing creams which may contain estrogenic substances. The anti-inflammatory steroid creams may also be employed for exacerbations of pruritis. If possible, avoid use of alkaline soaps, topical creams containing antihistamines, antibiotics, anesthetics, X-ray, and alcohol injections.

Tumors of Vulva

Vulvar pruritis, irritation, or pain may herald carcinoma of the vulva. In fact, any symptom—no matter how slight—referred to the vulva demands immediate inspection of the area. For some reason or other, patients with even advanced carcinoma of the vulva delay seeking medical advice and have a paucity of complaints. The clitoris should be carefully inspected, since it is a favorite site of malignancy in this area. Bartholin glands should also be palpated. A cyst of the Bartholin duct system is unusual in this age group, and the onus is on the doctor making such a diagnosis, for 2 to 3 percent of vulvar cancers originate in Bartholin glands. In general, *any ulceration*, no matter how superficial, or *any mass* in the vulvar area must be biopsied and *not* treated with topical applications as a therapeutic trial before pathologic analysis. The treatment of carcinoma of the vulva is radical vulvectomy with removal of the vulvar node bearing regions. Although it is a formidable procedure, it is remarkably well-tolerated by the aged female. Radiation therapy has little or no place in the management of this disease.

Leukoplakia of the vulva first appears as a whitened thickening of the epithelium which later degenerates with the formation of cracks and fissures. At that stage, a malignant transformation may take place in up to 5 percent of these cases. For this reason, the lesion must be followed closely with frequent biopsy. In fact, simple total or partial vulvectomy may be necessary if this condition seems progressive.

Urethral caruncle is a common lesion noted on vulvar examination. It is a cherry-red granuloma at the external urethral meatus. The diagnosis is usually obvious and treatment is rarely necessary, although surgical excision and cautery have been practiced.

VAGINA

The same changes occur in the vaginal canal that were noted in the vulva. The epithelium thins and becomes avascular. There is a loss of elastic tissue and the rugae tend to disappear. The canal thus may appear smooth, shiny, dry and pink-tinged. The caliber of the tube is smaller and there may be adhesions in the vault. In parous women, the introitus tends to gape and the vagina to roll outward.

Vaginal secretions are scanty and there is an alteration in the vaginal flora. Doderlein's bacillus is replaced by a mixed flora of anaerobic organisms, diphtheroids, nonhemolytic streptococci and staphylococcus. The pH rises toward the alkaline side of the scale. All of these factors tend to increase the susceptibility of the vagina to infections of specific or nonspecific nature.

Inflammation

"Senile" or atrophic vaginitis is quite common as a result of the altered bacterial flora and pH change secondary to estrogenic depletion. The patient notes soreness and pruritis of the vagina and vulva with a watery, purulant or brown leukorrhea. On inspection, the vagina is reddened, with numerous petechiae and superficial ulcerations. Cultures should be taken of the vagina along with "Pap" smears to rule out a malignant cause for the ulceration and bleeding that may be present.

The treatment of senile vaginitis is to provide estrogen locally in the form of suppositories or cream. This should be done nightly for 2 to 3 weeks. In addition, acid douches may be advised for an indefinite period as well as a re-emphasis of *perineal* and vulvar hygiene. This should include cleansing the area from front to back with water after bowel movements, followed by reapplication of the estrogen cream.

Occasionally a neglected or retained pessary or other foreign body may cause vaginal ulceration and infection. This usually clears promptly with removal of the object and local hygienic measures.

Monilial vaginitis in the elderly patient is rather unusual except in the presence of diabetes mellitus or antibiotic therapy. Trichomonas vaginalis vaginitis, although not uncommon, is found less often than in the reproductive years. The symptomatology, diagnosis and therapy of these specific vaginitides is the same as in the other age groups.

Tumor

Carcinoma of the vagina is a rare primary tumor, even in this age group. Any malignancy in the vagina is more commonly metastatic or a direct extension

from a cervical carcinoma. In any case, any proliferative or ulcerating vaginal lesion should be biopsied promptly. Chronic irritation from the prolonged use of a pessary may play some role in the etiology of this tumor, so that patients with pessaries in place should be followed closely with "Pap" smears. The treatment of primary carcinoma of the vagina includes radiation therapy and radical surgery, depending upon the location and extent of the tumor and the condition of the patient.

CERVIX

The same alterations described in the vulva and vagina take place in the aging cervix. The stroma atrophies and is largely replaced by connective tissue. The cervix becomes smaller and flush with the vault, as the vaginal fornices tend to disappear.

The endocervical epithelium also atrophies and the endocervical glands tend to seal over, forming Nabothian cysts. Actual stenosis and obliteration of the cervical canal may take place. This may be asymptomatic, since secretory activity is at a minimum. Occasionally, however, it can lead to the formation of pyometria when secretions are trapped in the uterine cavity. The patient then presents with fever and a tender, boggy uterine mass. Cervical stenosis takes an additional significance when one remembers that it may mask a carcinoma of the endometrium. The cervical canal must thus be probed for patency when investigating the female genital tract for malignancy with vaginal smears.

Inflammation

Occasionally the cervix becomes hypertrophied and infected with erosion and true ulceration. This takes place when the organ protrudes from the vagina as in cases of uterine prolapse. Obviously, such an organ must be biopsied, and smears must be taken to rule out malignant change.

Tumors

Endocervical polyps may present in this age group. Although they are most invariably benign, excision biopsy should be done in every case.

Carcinoma of the cervix can appear in extreme old age, although its incidence declines somewhat past the age of sixty. It thus must be considered in any patient with vaginal bleeding or malodorous blood-stained leukorrhea. Pain is not an early symptom and the growth of the tumor may be quite slow in the geriatric age group. Rarely, the disease may present as fecal or urinary incontinence, urinary retention, or uremia secondary to ureteral obstruction. On examination, the cervix may be indurated, nodular, and ulcerated, although occasionally little change is noted on the portio vaginalis. The cervix is usually quite friable when swabbed or probed. In all suspicious cases, "Pap" smears and multiple punch biopsies are indicated.

At present, therapy consists of radium and deep therapy (cobalt or supervoltage) or radical surgery, although the latter is rarely indicated in the very elderly. Palliative surgical procedures to correct uremia, bowel obstruction, or fistulae may, however, become necessary.

CORPUS UTERI

Normally, the elderly uterus becomes a very small, moveable organ, whose size may approximate that of a normal cervix. This atrophy may be so extreme as to lead one to think that a supracervical hysterectomy had been performed in the past. Similarly, the endometrium becomes markedly atrophic and it is not unusual to get a report of "insufficient tissue" at the time of endometrial biopsy or dilatation and curettage. The endometrium, however, never loses its capacity to respond to hormonal stimulation. This fact is of great importance, since the administration of estrogenic substances to these patients may cause postmenopausal bleeding. In addition, some patients continue to secrete low levels of endogenous estrogen of ovarian or adrenal origin, and this too may account for postmenopausal bleeding from a hyperplastic endometrium. The finding of adenomatous endometrial hyperplasia in an aged female should be regarded with some suspicion, since there is suggestive evidence that this lesion may be a precurser of true adenocarcinoma.

Carcinoma of the endometrium is the classic malignancy of the female genital tract in the aged female. It is wise to recall its statistical relationship to obesity, hypertension, and diabetes in this age group. The tumor usually presents as postmenopausal bleeding, and in early cases there are no other physical findings. Occasionally, one may encounter metastatic lesions in the vagina or a mass extending through the cervix. A pyometra may be the first sign. Since carcinoma of the endometrium accounts for from 15 to 50 percent of all cases of postmenopausal bleeding, it cannot be sufficiently emphasized that this symptom must be investigated by a thorough dilatation and curettage. Vaginal

"Pap" smears are not sufficient since their accuracy in this disease is in the order of magnitude of only 75 to 85 percent.

The treatment of endometrial carcinoma may be radiotherapy, surgery or some combination of the two, depending on the stage of the lesion and the medical status of the patient. In recent years, the trend has been toward more radical surgery and postoperative vaginal radiation. Rarely, one may encounter a polypoid mass in the vagina arising from the endometrium as a cause of vaginal bleeding and discharge. This tumor may have some of the histologic characteristics of a carcinoma and a sarcoma—hence the term carcinosarcoma or mixed mesodermal tumor. Some of these patients have had radium therapy to the uterus many years before. The treatment is surgical, if possible, but the prognosis is quite poor.

Myomata uteri rarely cause symptomatology during the geriatric period. Some retrogressive changes and calcification do take place. It is important to investigate any increase in size of a uterine myoma, since this may herald the development of a leiomyosarcoma. Laparotomy and hysterectomy are indicated in such a case. Similarly, laparotomy is indicated if a myoma assumes a lateral position and one is unable to differentiate it from a solid ovarian tumor. A submucous myoma may be forced through the cervix into the vagina by the shrinkage of the uterus. It then becomes a "fibroid polyp" and may cause postmenopausal bleeding. In general, it is not to be assumed that vaginal bleeding in an elderly woman is due to myomata! The myoma is very likely masking a coexistent endometrial carcinoma. Once again, a dilatation and curettage is mandatory.

Endometrial polypi are another cause of late postmenopausal bleeding. The diagnosis is made at the time of dilatation and curettage. Again, it is important that the entire polyp be sectioned for histologic study to rule out an early carcinoma.

FALLOPIAN TUBE

The Fallopian tubes, which also atrophy in the aged —appearing pale, straight and shortened—are rarely a geriatric problem. The incidence of carcinoma is quite low (less than 0.5 percent) although the prognosis is very poor (approximately 5 percent, 5-year survival). Unfortunately, in its early stages, there are no specific symptoms. There may be vaginal bleeding, discharge, and low abdominal colicky pain. Occasionally, "Pap" smears may be positive, although the cervical biopsy and dilatation and curettage will be negative. Any older patient with a persistent adnexal mass, vaginal bleeding, and a negative curettage must be considered a candidate for a carcinoma of the tube. The treatment of this disease is surgical. In fact, the diagnosis is most often made at the time of laparotomy for an adnexal mass. Surgical extirpation should be followed by external radiotherapy.

OVARY

Typical of the atrophy of this age, the ovary appears pale, thickened and small—often measuring only 1 to 2 cm. in length. On pelvic examination, in fact, it is rarely palpable. Since cyclic development of a follicle and corpus luteum no longer occur, there is no justification for labelling an ovarian cyst as "functional". All such tumors must be considered as new growths. The old rule that ovarian cysts less than 6 cm. in diameter need not be explored does not apply in this age group. In general, any persistent adnexal mass in a geriatric patient must be subjected to further investigation. This rather radical approach is essential when one recalls that there are no specific symptoms of ovarian carcinoma, and the deep location of this organ makes the diagnosis of malignancy by techniques such as smear and biopsy almost impossible. Only rarely will malignant cells exfoliated from the ovary appear in the vagina. If bimanual examination of the adnexae is unsatisfactory, one should not hesitate to examine the patient under anesthesia or even perform a posterior colpotomy or laparotomy to visualize the pelvic organs.

Most commonly, the patient with ovarian carcinoma presents with ascites and multiple pelvic-abdominal masses. Even in this type of patient, surgical exploration is usually indicated. Bulky masses can be removed and tubes left in place for the insertion of radioactive substances or alkylating agents. Postoperative X-ray therapy may also add to survival time and diminish ascites.

Functioning ovarian tumors, such as granulosa cell carcinoma, may appear after the menopause. These should be suspected in an elderly patient with a solid ovarian tumor and postmenopausal bleeding.

So called "Krukenberg Tumors" of the ovary may appear as bilateral, movable masses that appear grossly benign. Of course, these are metastatic and should call for a complete investigation of the gastrointestinal tract and breasts.

Benign ovarian tumors are not uncommon in the

aged female. Since they are indistinguishable clinically from their malignant counterparts, surgical exploration is again mandatory. They can, of course, twist, hemorrhage and rupture—just as in the younger age group.

Pseudomucinous cysts may grow to huge proportions in the elderly, and one should not hesitate in advising removal. Rupture of these histologically benign cysts can be catastrophic, with development of pseudomyxoma peritonei with its gelatinous exudate.

Fibromas of the ovary may be confused with carcinomata, since they may be accompanied by ascites and hydrothorax (Meigs' Syndrome). The treatment is surgical and leads to clearing of the abdominal and pleural fluid.

GENITAL PROLAPSE

Some degree of prolapse is the commonest cause for gynecologic complaint in the geriatric patient. These complaints may range from a pressure sensation and "ball" in the vagina to complete procidentia with inversion of the vagina and a mass noted between the legs. The patient may complain of backpain, pelvic "heaviness", and difficulty with bladder and bowel function, including attacks of cystitis, constipation, stress incontinence, or urinary retention.

The original damage to the pelvic floor, producing the prolapse, can usually be traced to the time of vaginal delivery, although a few patients have congenital relaxations. As the patient ages and the tissues lose their hormonal stimulus, the muscular and ligamentous supports weaken further and any combination of cystolcele, rectocele, enterocele and descensus uteri can ensue.

Urinary symptoms are prominent in the geriatric patient with significant prolapse. With cystocele formation, there is usually the appearance of residual urine. This stagnant urine becomes infected, leading to chronic cystitis and "urgency-frequency" syndrome. If there is urethrocele or loss of bladder neck support, the patient may develop stress incontinence in addition. As prolapse progresses toward procidentia, true stress incontinence disappears and may be replaced by urinary retention with overflow incontinence.

With large rectocele formation, there may be some diversion of the fecal stream into this blind pouch. The unhappy patient may have to insert a finger into the vagina to press the stool out of the rectocele in order to defecate.

Since elderly patients may tolerate their disorder for long periods of time, it is not unusual to find on examination an edematous, lichenified, inverted vaginal mass with an infected, ulcerated cervix as the leading edge. At times it is impossible to replace the mass because of the massive edema, and prolonged bed rest in Trendelenberg position along with soothing local applications are necessary before restoration of the vagina is possible.

The management of the patient with genital prolapse is primarily surgical. The gynecologist has numerous procedure at his disposal to restore pelvic architecture and correct urinary symptoms. Vaginal pessaries are to be avoided as a permanent form of treatment, since they eventually fail to provide adequate support and tend to cause ulceration and infection of the vaginal wall. They are only to be used as a last resort in the patient with severe medical contraindications to surgery. Remember that many of the vaginal surgical procedures can be performed under local anesthesia with a minimum of trauma.

HORMONAL REPLACEMENT IN THE POSTMENOPAUSAL FEMALE

With the development of orally active estrogenic and progestational substances, the controversy has developed as to whether or not to supplement the aged patient with sex steroids. Before considering this controversy, let us clarify the endocrine status of the postmenopausal patient. At the time of the menopause there is gradual ovulatory failure of the ovary, so that corpora lutea are no longer produced. Multiple small follicles, however, continue to produce estrogenic substances. As long as estrogen is produced, pituitary gonadotropin remains at premenopausal levels. Eventually, however, a lack of even follicular response results in a very low level of estrogen. With this failure of "feedback" regulation, the anterior pituitary secretes large amounts of gonadotropic hormone, principally FSH. There are authorities who are convinced that the postmenopausal ovary retains its capacity to produce estrogenic hormones for long periods of time. Others have shown that the removal of the ovaries after the menopause leaves the estrogen level unaltered, wheras adrenalectomy results in a pronounced fall. It is thus probable that the hormonal activity of the postmenopausal ovary is insignificant. It is of interest, however, that over 20 percent of patients in their seventies still show evidence of estrogen stimulation in their vaginal

smears. The source of this steroid is felt to be primarily the adrenal cortex.

In 1929, Fluhmann showed that the serum of postmenopausal women had large amounts of gonadotropin activity, although there was a marked cyclic variation in the amount. There is apparently some reduction of this gonadotropic activity between the ages of 60 and 70 years. Whether it is the "gonadotropic excess" or "estrogen lack" that is responsible for the typical menopausal symptoms of amenorrhea and vasomotor instability is at present not clear.

Parenthetically, although ovulatory failure is an early manifestation of the menopause, pregnanediol excretion continues long after ovulation ceases, although at a greatly reduced level. This, too, is thought to reflect adrenal secretion of progestational substances.

In summary, the aged patient is an individual with a markedly diminished sex steroid production and a somewhat elevated pituitary gonadotropin level secondary to the disruption of the pituitary-ovarian axis. What are the effects of this relative sex steroid lack? As mentioned before, amenorrhea, flushes and sweats due to vasomotor instability are the only menopausal symptoms that are amenable to estrogen replacement. In addition to this, osteoporosis, which occurs in approximately 25 percent of postmenopausal women, has also been attributed to lack of estrogen. Finally, there is excellent animal and epidemiologic evidence as well as clinical studies which indicate that estrogen lack can cause an increased incidence of coronary artery atherosclerosis. The administration of estrogen can, in some cases, reverse or arrest this degenerative process. There is evidence that estrogen will diminish blood cholesterol, reduce the cholesterol-phosphorus ratio, increase plasma phospholipids, elevate lipoproteins, and increase the alpha to beta lipoprotein ratio.

Because of these three principal factors, (1) control of vasomotor instability, (2) prevention of osteoporosis, and (3) prophylaxis against coronary vascular sclerosis, an increasing number of authorities have advocated long-term estrogen replacement, either on an intermittent or continuous basis.

Another group of authorities, again with adequate reasoning, object to the prolonged administration of exogenous sex steroids to the aged female. They point out that the vasomotor symptoms of the menopause are merely suppressed and recur on discontinuation of the therapy, and that it is better to allow the postmenopausal patient to adjust to the gradual fall of estrogen. They also note that there is suggestive evidence that there is a relationship between prolonged estrogen stimulation and carcinoma of estrogen sensitive organs, i.e., the breast and uterus. It has been known for many years that castration in the female is rarely followed by endometrial carcinoma, whereas delayed menopause is frequent in such patients. Many patients with endometrial carcinoma have shown previous evidence of prolonged estrogen stimulation in the form of hyperplasia of the endometrium. Certain functioning ovarian tumors, such as granulosa cell tumors, are also associated with a high incidence of endometrial carcinoma, as is Stein-Leventhal Syndrome and ovarian stromal hyperplasia. Carcinoma can also be produced in rabbits by prolonged administration of stilbesterol. Accordingly, these authorities feel that exogenous estrogen is contraindicated in the aged patient. They feel that the risk of carcinoma outweighs that of degenerative disease. They also point out that the administration of estrogen is not completely innocuous. Many patients have side effects, such as edema (which can be especially significant in cardiac patients) and reactivation of migraine headaches or endometriosis.

The conflict over whether or not to administer prolonged steroid therapy to the aged patient appears to be one stemming from opposing philosophies, rather that conflicting data, since both groups quote extensive supporting data to bolster their points of view.

Recently, it has been advocated that some of the analogs of testosterone may be used either alone or in combination with estrogenic substances in the management of the aged patient. It has been claimed that these substances can relieve fatigue, improve well-being, increase the appetite, and relieve osteoporosis because of their anabolic effect.

It is certainly true that these substances do have an anabolic effect; but the dissociation from their androgenic activity is not complete, and in dosages capable of affecting the metabolism, virilizing changes may be noted. Toxic effect of androgens must also be considered, including its effect on liver function, its tendency to raise cholesterol and beta-lipoprotein levels, and its ability to cause sodium retention. On the other hand, these substances may be indicated in the occasional patient with marked calcium loss after fractures and prolonged immobilization. In addition to their anabolic effect, they can diminish urinary calcium and therefore lessen the incidence of urinary calculi. The evidence at the present time, however, would indicate

that, if prolonged steroid therapy is to be used in the aged patient, it should be limited to the estrogenic substances.

Before undergoing prolonged steroid therapy, these patients should have a complete physical and psychological appraisal. Particular attention should be paid to breast and uterine contraindications to estrogen therapy. Symptoms should be controlled at the lowest possible dosage range, which is approximately one-fourth of the full estrogenizing dose. Medication should be administered orally, if possible, and the estrogen with the lowest incidence of nausea in that particular patient, utilized. The most popular preparations available at this time are (1) Diethylstilbestrol, .25 mg. per day; (2) sodium estrone sulfate, .625 mg. per day; and (3) Ethinyl Estradiol, .02 mg. per day. While undergoing this therapy, the patient should be kept under constant observation. Periodic breast palpation, pelvic examination and Papanicalou smears are mandatory.

SUMMARY

The following points must be reemphasized in the gynecologic evaluation of the geriatric patient:

1. Any mass, ulceration, or persistently tender area of the vulva and vagina must be biopsied. Prolonged topical therapy is indicated only after malignancy has been ruled out. It should not be used as a therapeutic trial before considering biopsy.

2. The progressive changes of aging may alter the pH and bacterial flora of the genital tract and thus predispose it to infection. It is necessary to return these toward normal by the use of buffered, acidifying medication and estrogenic applications, in addition to specific antibacterial therapy, in order to avoid chronic or recurrent infections.

3. Vaginal bleeding must be considered a quasi-emergency in this age group, requiring "Pap" smears, dilatation and curettage, and cervical biopsy as minimal procedures to rule out uterine malignancy. Patients with active endometrial hyperplasia should be observed closely for the development of carcinoma. Persistent vaginal bleeding with negative curettage should make one suspect an adnexal malignancy.

4. Any lateral pelvic mass, regardless of size, is an indication for further evaluation—up to and including laparotomy. Any pelvic or abdominal mass arising in the pelvis that seems to increase in size or becomes tender and painful should be explored.

5. In patients with symptoms of genital prolapse, the treatment of choice is surgical repair. Age itself is not a contraindication to elective surgery, provided preoperative evaluation, preparation and postoperative care are adequate. It is not chronologic age, but physiologic, mental and emotional status that must be evaluated.

6. The conflict over prolonged steroid therapy to the aged patient seems to stem from opposing philosophies rather than conflicting data. Present evidence seems to indicate that such therapy should be limited to the estrogenic substances. Patients should have a complete physical and psychological appraisal, with particular attention to breast and uterine contraindications. Symptoms should be controlled at the lowest possible dosage range, and medication should be administered orally, if possible.

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SECTION A/DISEASES AND DISORDERS MOST RELEVANT TO SINGLE ORGAN SYSTEMS

Part VIII/The Musculoskeletal System

COMMON DISORDERS OF MUSCLES IN THE AGED

By

David Grob, M.D.

Disorders of the muscles that occur in the aged may be divided into those which are the natural result of aging and those which result from disease. The former are presumed to result from the aging process and are seen in many "normal" aged individuals.

MUSCLE DYSFUNCTION IN "NORMAL" AGED PERSONS

Senile Muscular Wasting

Wasting of skeletal muscles and general decrease in muscular strength, endurance and agility are common in the aged. There is a decrease in the number of muscle fibers and in their individual bulk, which is merely part of a general atrophy of organs and tissue. The process of regeneration is not active. Fibrous tissue replacement occurs secondarily. The age at which these changes in the muscles begin is highly variable. The changes are particularly conspicuous in the small muscles of the hands, which become thin and bony with deep interosseous spaces. The arm and leg muscles become thin and flabby. The atrophy may be so prominent as to suggest progressive muscular atrophy. However, this disease can be excluded by the absence of severe weakness, muscular fasciculations at rest, or progression of signs and symptoms. While some degree of weakness may occur in patients with senile muscular wasting, it is usually surprisingly little and not in proportion to the degree of wasting.

Changes In Posture

In old age the posture tends to become one of general flexion. The head and neck are held forward, the dorsal spine becomes gently kyphotic, the upper limbs are bent at the elbows and wrists, and the hips and knees are also slightly flexed. This flexed attitude of old age is due in part to changes in the vertebral column and in the intervertebral discs, to ankylosis of ligaments and joints, to shrinkage and sclerosis of tendons and muscles, and to degenerative changes in the extrapyramidal central nervous system.

These factors also contribute to an increase in muscular rigidity, sometimes referred to as senile or arteriosclerotic rigidity. This is demonstrable clinically by resistance to passive movement, especially in the limbs and neck. The legs tend to be more affected than the arms and proximal segments of the extremity more than the distal. In its more severe form, this increased rigidity may result in the aged individual assuming catatonic postures and allowing his limb to be retained in whatever position it is placed. Mental inattention, perseveration and dementia may also contribute to this phenomenon.

Disorders of Movement

The aged person usually shows a decrease in movement, attributable mainly to impairment of the extrapyramidal system. He will have an impassive facial expression, infrequent blinking of the eyes, and a decrease in spontaneous and associated movements. When they occur, movements are characteristically slow. At times, a resting tremor may be present. The flexion attitude, rigidity, infrequency and slowness of movement, and tremor, when intense, constitute the parkinsonian state, attributable to degeneration of the extrapyramidal system. However, these signs are commonly seen in minor degree in normal old people, suggesting that this system is more vulnerable to the aging process than are other parts of the motor system.

Disorders of Reflexes

The tendon jerks tend to become decreased, particularly the ankle jerks, which are often unobtainable. The arm reflexes (supinator, biceps and triceps) are usually present, though diminished, while the knee jerks are the most likely to be preserved. The loss of ankle jerks may be due mainly to inelasticity of the Achilles tendon. Less marked decrease in other tendon jerks is probably due more to shrinkage and sclerosis of tendons and muscles than to changes in the spinal reflex arc. Loss of the abdominal reflexes is common and may occur as early in life as middle age. This may result from overstretching of the abdominal musculature by adiposity or by child bearing.

The plantar responses are often difficult to elicit, due mainly to deformities of the feet with valgus or equinovalgus deformities of the great toe, stiffness or ankylosis of the first metatarsophalangeal joint, and hardening of the sole. This results in a clear-cut flexor response being seen much less frequently than in younger individuals. However, a frank extensor response must be regarded as an abnormal finding, usually indicating a lesion of the upper motor neurone (pyramidal tract or motor cortex).

Disorders of Eye Movements

Defective upward gaze and defective convergence of the eyes are common "normal" findings in the aged. It is not clear to what extent this is due to alterations in the central nervous system or in the muscles. The pupils tend to become miotic and sluggish in their reflex response to light and to accommodation. The pupils may even become unresponsive to light while still contracting on accommodation (Argyll-Robertson pupils).

These changes are believed to be the result of fibrosis, hyalinization and lipoid infiltration of the smooth muscle of the pupillary sphincter. Lipoid infiltration of the cornea results in the presence of an arcus senilis, a familiar ocular evidence of aging. There is no clear relationship of the arcus senilis to chronologic age or to arterial degeneration. The arcus senilis tends to occur at an earlier age in patients who are hypercholesterolemic.

Muscular Fasciculations

Spontaneous fasciculations, which are visible as flickering movements of muscles, usually occur in the presence of muscular weakness and wasting and are then a manifestation of slowly progressive destruction of anterior-horn cells or cranial motor-nerve nuclei. However, spontaneous fasciculations occasionally occur in normal individuals, including the aged. When marked, they are termed *myokymia.* They occur particularly in the calves, eyelids, hands and feet and especially after fatigue or excessive loss of sodium chloride. The movements may resemble fasciculations due to anterior-horn cell disease, but if the latter can be excluded by the absence of significant weakness and wasting, the movements are of no significance. Fasciculations occurring in normal individuals are usually more irregular in rate and size and shorter in duration than those in anterior-horn cell disease.

Spontaneous fasciculations must be distinguished from *contraction fasciculations* which may occur during voluntary contraction of muscle that has atrophied due to any cause, including senile atrophy. These probably represent the contraction of isolated groups of motor units, which stand out because adjacent units are not responsive.

Muscle Cramps

This disorder is characterized by sustained involuntary and painful contractions of muscle. Cramps usually occur in one muscle group of the calf, foot, thigh, hand or hip, especially following unusual muscular effort and usually at night. They may occur at any age, but often become more troublesome with advancing age. They may occur as a result of peripheral vascular insufficiency, sodium deprivation or loss, decrease in the plasma concentration of calcium, hypoglycemia, certain toxins such as that of the tetanus bacillus and "black widow" spider, and, rarely, anterior-horn cell or peripheral nerve disease. In uremia, cramps and twitching may occur even in the absence of marked change in plasma calcium or sodium. However, in the great majority of instances, cramps occur in apparently normal individuals and their mechanism is unknown.

Cramps may frequently be terminated by passive stretch. Their incidence may be diminished by a hot bath at bedtime, by orally administered quinine sulfate, which lengthens the refractory period of muscle, presumably by slowing repolarization, or by mephenesin or benadryl, which may diminish spinal cord reflex activity. Muscle cramps also occur in association with certain diseases of muscle, including the stiff-man syndrome, McArdle's syndrome (phosphorylase deficiency), congenital myotonia, and to a lesser degree,

myotonic dystrophy, hypothyroid myopathy and paroxysmal myoglobinuria.

Restless Legs

In this condition the patient complains of paresthesias in the legs. Since the paresthesias are usually relieved by motion of the legs and reappear only when the legs have been quiet for a while, the patient tends to keep the legs in motion. The disorder may occur at any age, but tends to become more troublesome with advancing age. It may occur without evident cause, or it may result from lumbar osteoarthritis (spondylosis), compressing nerve roots, or from functional hypoglycemia.

MUSCLE DYSFUNCTION DUE TO DISEASE

Skeletal muscle dysfunction may result from impairment of any part of the path taken by the stimulus for voluntary movement (the motor unit), from the highest cerebral centers to the motor cortex, pyramidal (corticospinal) tract, motor nuclei of the brain stem and anterior-horn cells of the spinal cord, peripheral motor nerves, neuromuscular junction and muscle fibers. The manifestations of muscle dysfunction are limited.

Weakness occurs in almost all disorders of the neuromuscular system and is usually the presenting complaint. Weakness is accompanied by muscular wasting in diseases of the lower motor neuron (anterior-horn cells and peripheral motor nerves) and in primary diseases of muscle. It is accompanied by stiffness or spasm in diseases of the upper motor neurone (motor cortex and pyramidal tract) or extrapyramidal system, and in tetany, tetanus, myalgia, scleroderma and occasionally myositis. Weakness is accompanied by muscle pain or tenderness in spinal cord tumor, intervertebral disk, trichinosis, myalgia, and in some instances of peripheral neuritis and myositis. Weakness is associated with abnormal movements such as fasciculations in progressive muscular atrophy, and occasionally in syringomyelia or hyperthyroidism, and with grosser abnormal movements in some diseases of the extrapyramidal system.

The many causes of muscle dysfunction may be considered in the order in which they affect the passage of the motor stimulus, beginning in the frontal cortex and terminating in the muscle fibers. Disorders which affect the aged will be emphasized.

Disorders Arising Primarily From the Nervous System

Emotional Disorders

The impulse for voluntary motor activity arises in the frontal cortex and any impairment in volition may result in symptoms of weakness or fatigue. This may take the form of local weakness or paralysis as in hysteria, generalized weakness and fatigue as in neurasthenia, weakness with catatonia as in schizophrenia, or weakness with wasting as in anorexia nervosa. Weakness or fatigue of emotional origin is frequently accompanied by a general increase in muscle tension associated with anxiety and by incomplete muscle relaxation during rest or sleep. The increased muscle tension may result in pain in the back of the neck or head, headache, postural deformity, backache, pain in and around joints simulating rheumatism, and even generalized muscle soreness.

Tension and anxiety in the aged may result from financial insecurity, rejection by children, lack of flexibility, and inability to adapt to new circumstances. Aged people often react to rejection with anger, irritability and querulousness. After a time anxiety may give way to apathetic indifference, depression or major psychosis.

The diagnosis of weakness or fatigue of emotional origin can be made only after careful exclusion of the many other causes of weakness, but is often suggested by a history of anxiety and increased muscle tension, fatigue on awakening, early evening drowsiness, and improvement in symptoms following suggestion or placebo administration. However, it must be kept in mind that weakness of emotional origin may be superimposed on weakness due to other cause and the distribution of the weakness of emotional origin is sometimes determined by an underlying loss of function. In such instances, the major part of the disability may be relieved following hypnosis, placebo or other forms of suggestion, but evidence of the underlying disease process remains.

Upper Motor Neurone Disorders

Injury to the motor cortex or the pyramidal tracts may result from vascular disease (thrombosis, hemorrhage or embolism of cerebral or spinal vessels), infection (encephalitis, meningitis, abscess, syphilis), disseminated sclerosis, pernicious anemia, amyotrophic lateral sclerosis, or brain or spinal cord tumor. An upper motor neurone lesion can usually be identified by its characteristic manifestations: weakness on the

side of the affected pyramidal tract, with spasticity which is greater in the flexors of the upper extremities and in the extensors of the lower extremities, exaggerated tendon reflexes, diminished abdominal and cremasteric reflexes, clonus and extensor plantar reflex.

Lower Motor Neurone Disorders

Injury to the motor nuclei of the brain stem, to the anterior-horn cells of the spinal cord, or to the anterior roots or motor nerves, results in the characteristic manifestations of a lower motor neurone lesion: weakness or paralysis of the muscles innervated by the affected neurones, accompanied by diminished tone, softness and wasting, and diminution or loss of tendon reflexes. The distal parts of the extremities are more affected than the proximal. Slow degeneration of the anterior-horn cells, as occurs in progressive muscular atrophy and occasionally in syringomyelia, intervertebral disc or spinal cord tumor, results in fascicular twitching of muscle. Disease of the peripheral nerves may also result in sensory loss and occasionally in visceral dysfunction, such as the nocturnal diarrhea of diabetic neuropathy.

Peripheral neuritis of infectious or toxic origin is more common in younger individuals, while that due to deficiency of diet or absorption or to metabolic, vascular or neoplastic disease is more common in older individuals. The commonest form of polyneuropathy in elderly patients is that associated with diabetes mellitus. Occasionally, the neuropathy may take the form of a mononeuritis or a neuritis involving only the upper or lower extremities. Older individuals, particularly those who are thin or diabetic, are more prone to develop compression neuropathy of the peroneal nerve due to crossing the legs; to have late ulnar palsy several years after injury to the elbow; or to have compression of the median nerve in the carpal tunnel, due to osteoarthritis or local tenosynovitis at the wrist. Carcinoma may result in neuropathy due to local invasion or to a "toxic" reaction to the carcinoma.

Disorders of the Neuromuscular Junction

Myasthenia Gravis

Myasthenia gravis is a chronic disorder of neuromuscular transmission, characterized by weakness and abnormal fatigability. The muscles innervated by the cranial nerves are particularly affected, and usually those of the neck, trunk and extremities. In severe disease, weakness of the muscles of respiration occurs. Smooth and cardiac muscle is not involved. The disease usually becomes generalized, but in a minority of patients it remains localized to the extraocular muscles. The symptoms are commonly ameliorated, although to a variable degree, by anticholinesterase compounds. This response serves as the basis for diagnosis and management of the disease.

Onset of the disease may occur at any age, but the peak is in the third decade in women and in the third through the seventh decade in men. After the age of 60, onset of the disease is much more common in men.

The initial manifestations are most commonly referable to the extraocular muscles. The initial symptoms are ptosis in approximately 25 percent of patients, diplopia in 24 percent of patients, and weakness of legs, difficulty in swallowing, or generalized weakness in the remainder. Older patients, particularly older men, tend to have a more severe and progressive form of the disease and fewer spontaneous remissions than young patients. Male patients are less likely to have spontaneous remissions than females.

Carcinomatous and Other Myasthenic Syndromes

Muscular weakness and fatigue, with distribution and temporal characteristics similar to myasthenia gravis but with little or no response to anticholinesterase compounds, occasionally occur without any detectable associated disease or in association with neoplastic disease, polymyositis, disseminated lupus erythematosus, peripheral neuropathy or amyotrophic lateral sclerosis. The best studied of these myasthenic syndromes is that associated with neoplasm, particularly small-cell bronchogenic carcinoma. The syndrome resembles myasthenia gravis in symptomatology and usually in increased reactivity to d-tubocurarine and abnormal reactivity to decamethonium and succinylcholine. It differs from myasthenia gravis in that only a minority of patients respond to neostigmine. In some patients weakness appears many months before the tumor is noted while in others it follows the tumor.

Disorders of Muscle Due to Electrolyte Disturbance

Hypokalemia

Hypokalemia may develop when there is deficient intake or absorption of potassium, substantial loss in vomitus, stool or urine, or marked intracellular movement of the ion. Excessive potassium loss in the urine with adrenal steroid administration, during the use of some diuretics, and in the presence of protein increased

catabolism is particularly important in the elderly person.

Hypokalemia due to any cause, if sufficiently severe, results in impairment of function of skeletal, cardiac and smooth muscle. This is more likely to occur after rapid reduction in plasma potassium concentration than after gradual reduction. Weakness due to hypokalemia characteristically involves the muscles of one or all extremities, the trunk and neck and sometimes the muscles of respiration. The tendon reflexes and muscular contraction in response to direct percussion are diminished.

Hyperkalemia

Hyperkalemia results mainly from deficient renal excretion of the ion due to anuria or oliguria, from excessively rapid potassium administration, from intravascular hemolysis, from acute acidosis, and from crush injuries. Hyperkalemia, if sufficiently severe, results in impairment of function of skeletal, cardiac and smooth muscle. Weakness due to hyperkalemia clinically resembles that due to hypokalemia, but the electromyographic and electrocardiographic alterations are different.

Patients with atrioventricular block appear to be particularly susceptible to the cardiac effects of hyperkalemia, which may increase the block, retard impulse propagation and depress the ventricular pacemaker with resultant asystole. Conversely, production of mild hypokalemia by chlorothiazide administration has been reported occasionally to reduce the incidence of Stokes-Adams attacks due to atrioventricular dissociation.

Disorders of Muscle Due To Endocrine Disturbance

Weakness may occur when there is either deficient or excessive function of the thyroid, adrenal cortex or anterior pituitary glands. It may also occur when there is hypocalcemia (with tetany), hypercalcemia or hypoglycemia arising from any cause.

Hyperthyroidism

Approximately 70 percent of patients with hyperthyroidism have mild to moderate muscular weakness, with easy fatigability and a varying degree of muscle wasting and weight loss. This tends to be more severe in older patients. Weakness is usually most prominent in the muscles of the pelvic girdle and upper legs, with difficulty in climbing stairs, and less often in the shoulder girdle and upper arms with difficulty in elevating the arms. Muscle wasting tends to be more generalized, involving distal as well as proximal muscles, but the quadriceps and temporal muscles are often involved to a greater degree than others.

Chronic Thyrotoxic Myopathy

While the majority of patients with hyperthyroidism have mild to moderate muscular weakness and wasting, a smaller proportion have more pronounced evidence of disturbance in muscle function. The commonest generalized myopathy is the gradual development of a pronounced degree of muscle weakness and wasting to which the term chronic thyrotoxic myopathy has been applied.

In chronic thyrotoxic myopathy, there is more marked weakness and symmetrical muscle wasting than occurs in the great majority of patients with uncomplicated hyperthyroidism. Most patients with chronic myopathy differ in some ways from those with uncomplicated hyperthyroidism. In patients with thyrotoxic myopathy, exophthalmos is usually not prominent, the thyroid gland may or may not be grossly enlarged, and the usual manifestations of hyperthyroidism such as tachycardia, sweating, heat intolerance, tremor and hyperkinesia may or may not be noted or may be overshadowed by the marked weakness, muscle wasting and weight loss which are usually the principal symptoms.

Some patients may actually be depressed and anorectic and may be said to have "masked" or "apathetic" hyperthyroidism. In these patients, who are usually in the older age group, the only clue to the diagnosis may be weakness or wasting, auricular fibrillation, or heart failure. Such patients may be thought to have the cachexia of malignant disease, but treatment will result in dramatic benefits once normal thyroid function is restored.

Ocular Myopathy

Ocular myopathy is the commonest myopathy associated with thyroid disease. The relationship to thyroid function is probably indirect, since the muscular symptoms may develop with or without thyrotoxicosis and have been ascribed to increased activity of the thyroid-stimulating hormone (TSH) or, more likely, of some other secretion of the anterior pituitary gland. Eye signs may develop before there is evidence of hyperthyroidism, may be severe when there is minimal thyrotoxicosis, or may progress after amelioration of thyrotoxicosis. The most severe instances of exoph-

thalmic ophthalmoglegia develop in older patients following the relief of hyperthyroidism by thyroidectomy.

Hypothyroidism

The slowing of physical activity that characterizes hypothyroidism is due not only to the lethargy and mental sluggishness that occur in this disease, but also to alterations in skeletal muscle. Almost all hypothyroid patients complain of subjective weakness, usually of mild degree, and nearly one-third have objective weakness, primarily of the proximal muscles of the shoulder girdle and hips. The weakness is usually not marked. There also commonly occurs slowness of movement, which is due in part to retarded mental activity and also to an actual slowness of muscular contraction and relaxation. Hypothyroid patients often complain of muscular stiffness and occasionally have aching muscles, spasms, and even painful cramps, especially in the calves and low back. The slowness of muscle movement that occurs in most hypothyroid patients is well seen in the characteristic retardation of the response to the tendon reflex, particularly the relaxation phase.

In contrast to the muscular wasting that occurs in hyperthyroidism, hypothyroid patients have either normal or increased muscle bulk. The hypertrophied muscles are firmer than normal and may become even harder and more swollen after exercise, with aching and local tightening. The hypertrophied muscles are either of normal strength or are slightly to moderately weak. They are never of increased strength.

In patients with severe and protracted hypothyroidism, coma may occur, accompanied by hypothermia and marked slowing of respiration and, in one-fourth, by convulsions. Artificial respiration may be required to prevent carbon dioxide narcosis. The mortality rate of patients with myxedema coma is extremely high.

The term "masked hypothyroidism," like "masked hyperthryoidism," has been introduced in an attempt to draw attention to the atypical picture of the disease. There is an increasing belief that many older people may have unsuspected "subclinical" or mild hypothyroidism, with nonspecific complaints, such as weakness, muscle cramps, apathy, weight gain, constipation, menorrhagia and sometimes nervousness.

Hypo- and Hyperadrenocorticism and Hypo- and Hyperpituitarism

Weakness is a prominent manifestation of hypoadrenalism (Addison's disease) and hypopituitarism (Simmonds' disease, Frohlich's disease) and may also occur in hyperfunction of the adrenal glands or pituitary gland (Cushing's syndrome, acromegaly). Muscle weakness occurs in 80 percent of patients with Cushing's syndrome and sometimes is accompanied by wasting. Similar symptoms may be seen with prolonged steroid therapy (adrenal corticosteroids), and there may be increased creatinuria and even muscle necrosis.

Disorders of Muscle Due To Inflammatory Disease

Varying degrees of muscle weakness and wasting, associated with round-cell infiltration, perivascular collections of lymphocytes, and degeneration, necrosis and atrophy of muscle fibers, may occur in association with any of the inflammatory connective tissue or collagen diseases which have been attributed to hypersensitivity. They are marked in rheumatoid arthritis and in some patients with disseminated lupus erythematosus, periarteritis nodosa or scleroderma, and they are most severe in dermatomyositis or polymyositis.

In one special form of periarteritis, temporal arteritis, there is a late age of onset, usually between the age of 60 and 80. This disorder may be limited to one or both temporal arteries, or the temporal arteritis may be the predominant involvement of a more generalized periarteritis. The symptoms consist of localized headache, fever, anorexia, tenderness and nodularity of the temporal artery, blindness (in up to half the patients), and rarely diplopia. The disease usually responds well to the administration of corticosteroids.

The least well defined of the collagen diseases is polymyositis, which is characterized by weakness, wasting, and round-cell infiltration in proximal muscles. In some patients with the most chronic course, usually above the age of 30, the clinical and histologic manifestations may resemble those of muscular dystrophy, although the serum levels of transaminase and aldolase enzymes are usually higher. The presence of nodular accumulations of leucocytes and evidence of muscle regenerative activity are most suggestive of polymyositis or one of the other inflammatory diseases. It is likely that polymyositis itself may have several etiologies, and some investigators have preferred to apply the term "late onset myopathy" in patients over the age of 30. In patients between the ages of 30 and 50, the most common associated disorder has been one of the collagen diseases (including even Sjogren's syn-

drome), while in those past 50, three-fourths of the males and one-fourth of the females have had an associated neoplasm, most frequently in the lung, breast, stomach or ovary. The myositis may either precede or follow the appearance of the tumor and may or may not improve following removal of the tumor. The administration of adrenocorticosteroids usually suppresses the acute manifestations of the disease.

Disorders of Muscle Due To Other Causes

Diabetic Amyotrophy

Weakness and wasting of the muscles of one or several extremities, usually involving the distal musculature first, is common in patients with diabetes mellitus. Peripheral neuritis is the commonest cause. Accompanying sensory changes may facilitate diagnosis. In some patients, however, the proximal muscles of the lower extremities are affected first, and histologic studies have provided evidence that muscle as well as nerve may be affected. These patients, who have been mainly elderly male diabetics, have also had myalgia with anterior thigh pain and marked muscle wasting and weight loss. The disease is "self-limited" and improvement or recovery occurs within a few months to several years.

Atherosclerosis

Atherosclerosis of the large arteries to the lower extremities may result in fatigue, weakness and intermittent claudication on effort, and cramps. The decrease in muscular power and endurance that occurs with advancing age is commonplace. The legs are traditionally the first of an athlete's assets to fail. However, while atherosclerosis results in a decrease in endurance and work tolerance, it does not prohibit less strenuous muscular activity, unless arterial occlusion and gangrene occur. It is of interest that atherosclerosis seldom extends to the intramuscular arteries and, when it does, only the larger arteries tend to be involved. This is explained by the fact that most of the intramuscular arteries are small and atheromatous plaques are rarely seen in blood vessels less than 250 microns in diameter. However, occlusion of intramuscular blood vessels may occur in inflammatory disease of the arteries, as in polyarteritis nodosa and lupus erythematosus.

Emaciation and Cachexia

Generalized muscular wasting and weakness may result from chronic malnutrition, whether due to starvation or intestinal malabsorption, and is also seen in such "wasting" diseases as cancer and tuberculosis. Along with the loss of subcutaneous fat, all of the muscles become wasted and weakened, though usually not as weak as may be expected from the degree of atrophy. In addition, the muscles may show an unusual excitability to mechanical stimulus. A sharp blow to the belly of the muscle with a percussion hammer causes an immediate local contraction in the form of a visible ridge, which persists for several seconds and may give rise to a small wave which slowly moves along the muscle. This reaction is known as myedema or "idiomuscular contraction." The propagated contraction wave is electrically silent.

Senile Myosclerosis

Some aged persons who have been immobilized for a prolonged period develop progressive disuse atrophy and weakness of muscles, retraction of the wasted muscles and their tendons, and contractures of the limbs. The legs may be held in extreme flexion and standing and walking may become impossible. The resulting picture, which has been termed senile myosclerosis, superficially resembles that produced by dermatomyositis. However, the disorder is probably not the result of a specific myopathy, but rather of immobility, disuse atrophy and secondary contracture.

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PREVALENT JOINT DISEASES IN OLDER PERSONS

By

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OSTEOARTHRITIS

Osteoarthritis (also called hypertrophic arthritis, senescent arthritis, osteoarthrosis, degenerative joint disease) is a noninflammatory disorder of movable joints, characterized by deterioration and abrasion of articular cartilage and by formation of new bone at the joint surfaces.

Incidence

Histologic changes of osteoarthritis are present universally after the second decade of life and the degree increases with age. Radiologic changes are usually present after the age of 50, though only 5 percent of individuals over age 50 have clinical symptoms. After the age of 60, 15 percent of men and 25 percent of women have symptoms.

Pathology

The initial change appears to be injury to cartilage, which is followed by proliferation of adjacent bone. The cartilage first loses its elasticity, becoming dull and opaque, and later softened and frayed, denuding the underlying bone. Where the joint cartilage is thinned, the subchondral bone develops proliferation of fibroblasts and new bone formation takes place. The thickened cortical bone is called eburnation. At the joint margins, the periosteal bone proliferation forms bony spurs termed osteophytes. Subchondral cysts may develop. Small pieces of cartilage and bone may break off to form loose bodies in the joint. The joint capsule and synovium become thickened. While the joint disease is not due to inflammation, trauma of the synovial membrane by bony spurs may give rise to transient inflammatory changes.

Predisposing Factors

The main predisposing factor in osteoarthritis is advancing age. However, it is not clear to what extent this is the result of cumulative insults to the articular tissue or of senescent change in cartilage, with diminution in chondroitin sulfate content and "unmasking" of collagen. There is some evidence for diminished polymerization and hyaluronic acid content of synovial mucin. Injury to joints, whether major or minor, may predispose to osteoarthritis, perhaps as a result of irregular pressure. Abnormalities of joints associated with laxness of the ligamentous structures, such as congenital dysplasia of the hip, recurrent luxation of the patella or shoulder, genu recurvatum and knock knees, predispose to local changes. Excessive use of a joint, for occupation or other reasons, accelerates local changes. Obesity has also been generally accepted as predisposing to osteoarthritis. While this is presumed to be due to the mechanical burden on joints undergoing abrasion, the joints affected may include some that are not weight-bearing. A role for genetic factors is indicated by familial incidence of the disease, particularly with regard to involvement of terminal interphalangeal joints. The role of metabolic factors is poorly understood, but is suggested by the increased incidence and severity of osteoarthritis in patients with acromegaly or with ochronosis associated with alcaptonuria.

Joints Involved

Osteoarthritis affects mainly the weight-bearing joints (knees, hips, lumbar spine), shoulders, cervical spine and terminal interphalangeal joints of the fingers. Less often there is involvement of the first metatarso-phalangeal, temporomandibular and proximal interphalangeal joints of the fingers. Except where one joint is subjected to chronic trauma, the disease seldom remains monarticular for a long time. On the other hand, generalized involvement with simultaneous symptoms in all of these joints is very rare. Involvement of the wrists, elbows or feet (other than "bunion joint") is rare except after trauma.

Clinical Manifestations

These are local, but cannot be correlated with the degree of joint changes found either pathologically or radiologically. Only a small proportion of patients with joint changes have local symptoms, and systemic signs or symptoms do not occur, except for weakness and muscle wasting which may result from immobilization.

The main symptom is joint pain which occurs on motion and weightbearing ("friction effect") and is

relieved by rest. The pain is usually aching and is rarely intense. As with other types of joint disease, it may be increased just before change in the weather. Stiffness after sitting ("articular gelling") or on arising may occur, but persists for only a few minutes, in contrast to the stiffness of patients with rheumatoid arthritis, which may persist for hours.

Physical examination usually reveals crepitation on joint motion. There may be hard enlargement of the joint, due mainly to bony and cartilaginous overgrowth, particularly of the terminal interphalangeal joints (Heberden's nodes) and the knees. While there may be some local tenderness and a slight increase in synovial fluid, especially in the knees, effusion and signs of inflammation are usually negligible except following trauma. Limitation of joint motion may occur as a result of pain, muscle spasm, contracture of capsule, fascia or muscle, incongruity of joint surfaces or osteophyte formation; but flexion deformities are much less severe than in rheumatoid arthritis. Abnormalities of posture and gait may occur and may cause muscle pain and soreness. The course of osteoarthritis is usually slowly progressive, without characteristic exacerbations or remissions.

The clinical manifestations vary with the predominant site of involvement. In most instances, only one set of joints, or sometimes two, produce symptoms.

Terminal interphalangeal joints.

Heberden's nodes may appear after trauma or may occur without preceding trauma, particularly in women. They may be asymptomatic or may cause local aching (especially on exercise), tenderness, redness, clumsiness, and numbness and tingling. The joint may become flexed or displaced laterally. Many patients do not develop symptoms elsewhere.

Knees.

The knee joints are probably more frequently affected by osteoarthritis than any other joints. The site of cartilage breakdown is usually the weight-bearing surfaces of the femoral and tibial condyles and the posterior surface of the patella. Focal involvement of these areas may produce symptoms despite negligible X-ray changes. Atrophy of the quadriceps may develop as a result of disuse secondary to pain.

Hips.

Osteoarthritis of the hips, which has been termed malum or morbus coxae senilis, is the most disabling site of the disease. It is more common in men and is unilateral in approximately half of the patients. The pain, which occurs on motion, may be referred to the groin, buttock, sciatic region or inner aspect of the thigh or knee. Limitation of motion of the hip, especially abduction, extension and internal rotation, results from exostoses. The leg is often held in eversion, with the hip flexed and abducted. The gait is often awkward and shuffling, and even sitting, or arising from this position, may be difficult.

Spine.

The spine is the commonest site of radiologic change due to osteoarthritis (spondylosis) in men, and second only to Heberden's nodes in women. However, symptoms are usually absent or mild (backache, stiffness, limitation of motion), except in the minority of patients who develop compression of nerve roots (radiculopathy) or of the spinal cord (myelopathy).

The primary pathologic process is degeneration of the intervertebral discs, which results in increased stress at the lips of the vertebral bodies and zygophyseal joints, leading to osteophyte formation and narrowing of the intervertebral foramina. Osteophyte formation or protrusion of intervertebral discs may cause compression of nerve roots or spinal cord, especially in the cervical (C4–7) and lumbar spine.

Symptoms may occur acutely, particularly after trauma such as "whiplash" injury, or chronically. Compression of nerve roots results in pain, the distribution of which depends on the roots affected and may include the head, neck, shoulders, arms, digits or chest. The pain may be aggravated by active or passive movement of the spine and may be accompanied by muscle spasm. There may also be sensory changes (paresthesias, dysesthesias and hypesthesia) and signs of lower motor neurone lesion (muscle wasting and weakness, diminished tendon reflexes and occasionally fasciculations) in the dermatome innervated by the affected root.

When the sixth cervical root is involved, the sensory symptoms are felt in the thumb and index finger and when the seventh cervical root is affected, the middle finger. The spinalis, deltoid, biceps, brachioradialis and supinator muscles are those most affected when there is compression, of the fifth cervical root. In the case of the sixth cervical root, the muscles involved are the triceps, extensors of the wrists and digits, pectoralis major and latissimus dorsi.

Compression of the spinal cord may result in sensory symptoms and lower motor neurone signs at the

level of compression and upper motor neurone signs (weakness, spasticity, increased tendon reflexes, diminished abdominal reflexes and extensor plantar reflexes) below the compression, mainly in the lower limbs. Occasionally tactile or postural sensibility may be diminished below the level of compression. Sphincter control is usually unaffected unless there is severe paraplegia or quadriplegia. The cerebrospinal fluid is usually normal, but occasionally the protein content is slightly elevated and there may be delayed rise and fall of pressure in the Queckenstedt test when the neck is passively extended.

The vertebral arteries enter the cervical spine at the level of the sixth cervical vertebra and pass upward through a canal in the transverse processes. Cervical osteoarthritis may result in symptoms of cerebral ischemia, particularly if collateral circulation through the circle of Willis is impaired by atheromata in the vertebral or carotid arteries. Transient episodes of giddiness or syncope may occur at rest, on standing, or particularly after rotation or extension of the neck or, less frequently, flexion. A drop attack may occur, in which the patient suddenly falls, without impairment of consciousness. A persistent cerebral ischemic lesion (stroke) may occur after movement or manipulation of the neck.

Ribs

At the level of each costovertebral joint, the intercostal nerve leaves the spine and passes along the rib. Osteoarthritis of these joints may occasionally produce pressure on the intercostal nerves and pain referred to the chest wall or upper abdomen (intercostal neuralgia).

Roentgenographic Manifestations

The principal changes are joint narrowing (due to degeneration and disappearance of articular cartilage), sharpening of articular margins and intra-articular structures (e.g., tibial tubercles), bony sclerosis (eburnation), osteophytes and marginal lipping, and bone cysts. However, there is frequently no relation between the clinical and radiologic picture, and the diagnosis should seldom be made on the roentgenographic findings alone. In a few patients focal changes may produce symptoms despite a normal roentgenographic appearance. More frequently, there are radiologic changes of osteoarthritis without symptoms. It is not infrequent for rheumatoid arthritis, gout and other diseases to occur in persons with asymptomatic osteoarthritic changes. In evaluating a roentgenograph, the "normal" for the patient's age should be kept in mind.

In the diagnosis of osteoarthritis of the spine, X-ray detection of posterior osteophytosis with reduction in diameter of the spinal canal, spinal foramina and intervertebral disks, as well as myelography, is helpful.

Laboratory Findings

There are no specific laboratory abnormalities. The sedimentation rate, white blood count, hematocrit and serum proteins are usually normal unless some other disease process coexists. When effusions are present, the synovial fluid shows normal cytological and chemical values except for inconstant elevation of the mucin content. The presence of cartilage fragments and fibrils in the synovial fluid is characteristic of osteoarthritis.

Associated Diseases

There is a greater incidence of obesity and of strong laterality and stocky build in patients with osteoarthritis. Since incidence of the disease increases with age, above the age of 40 patients may develop any of the diseases to which their age group is prone, including atherosclerosis with coronary or cerebral sclerosis, hypertension, heart failure, prostatism, urinary tract infection, etc. When the patient becomes bedridden for any cause, the symptoms of osteoarthritis may diminish.

Treatment

Reassurance

The patient should be reassured that while his disease is annoying, it is not likely to spread to other joints or to produce serious disability.

Rest

Since intra-articular physical stress plays an important role in pathogenesis, involved joints should be rested periodically and should not be subjected to excessive exercise. When weight-bearing joints are affected, local supports including the use of canes, crutches or other mechanical devices, and intermittent rest in bed or on a couch are helpful. Patients with spinal disease should use a bed board for adequate support during recumbency. Unnecessary walking and stair climbing should be avoided. Obesity should be treated by weight reduction. Poor body mechanics causing chronic irritation to joints should be corrected if possible. Faulty position should be corrected and proper support prescribed for pronated feet, genu val-

gum and varum, and curvatures of the spine. Faulty work habits should be corrected. However, excessive rest should be avoided, as this may cause articular gelling and stiffness and atrophy of cartilage and muscle.

Physical Therapy

Heat, massage and mild exercise produce some symptomatic relief in most patients. Heat may be dry (electric pad, infrared, diathermy or ultrasound) or moist. Massage should be gentle over joints, but may be more vigorous over muscles to help prevent atrophy. Isometric exercises are helpful in improving muscle strength and preventing atrophy.

Analgesics

Acetylsalicylic acid (0.6 to 0.9 gm 3 to 5 times a day) and dextropropoxyphene (Darvon, 64 mg 3 to 5 times a day) are useful drugs for relief of pain in most patients. When these drugs do not provide relief, indomethicin (100 mg a day) or phenylbutazone (Butazolidin, 300 mg a day) may be administered provided the patient is followed closely for observation of toxic effects (nausea, vomiting, epigastric distress, rash, edema, anemia, leukopenia, thrombocytopenia). Intra-articular injection of hydrocortisone or its analogues may provide temporary benefit, but systemic administration of adrenal corticosteroid hormones or corticotropin is not of value and should not be employed.

Traction

This may be helpful in patients with spondylosis and symptoms of nerve root or cord compression not relieved by bed rest. For cervical spondylosis, a simple rolled towel splint or a Thomas collar may be worn for several weeks. If this does not relieve symptoms or if the disease is in the lumbar spine, the patient may be hospitalized for a few days of intermittent or constant head-halter traction or intermittent motorized traction.

Surgery

Few patients require surgical procedures, but these are occasionally performed when symptoms of hip, knee or spine disease are severe and are not relieved by other measures. Since aged individuals are more likely to develop postoperative complications, they should be operated on only when this is deemed essential. In patients with severe restriction of hip motion, mobility may be improved by incision of the hip capsule or of the surrounding muscles (hanging-hip operation). Severe hip pain can be relieved by arthrodesis, but this is practical only for unilateral disease. When there is extensive destruction of the femoral head, prosthetic arthroplasty may be helpful. When chondromalacia of the patella is very painful, patellectomy may be performed. In patients with spondylosis and intractable symptoms of nerve root or cord compression, the nerve root can be decompressed by removal of foraminal osteophytes or of the posterior wall of the intervertebral canal, or the cord can be decompressed by removal of degenerated disc material and spurs by the anterior route. These procedures are usually followed by fusion of the vertebrae. Since surgery on the cervical spine has major risks, it should be employed only in patients who are disabled by localized root or cord compression and only after a thorough trial of conservative measures.

RHEUMATOID ARTHRITIS

Rheumatoid arthritis is a systemic disease of connective tissue in which joint inflammation is the predominant manifestation. The cause is unknown, but may be related to hypersensitivity. In most patients the course of the disease is chronic and progressive, leading to characteristic deformities and disability.

Incidence

The disease may begin at any age from the first year of life to the ninth decade, but usually begins between the ages of 20 and 60, with peaks at 35 and 45. In 2 percent of patients, onset is after the age of 65. Population studies suggest an incidence of approximately 0.5 percent in the general population, 1.5 percent in the population over the age of 30, and 2 to 3 percent in the population over the age of 55. The disease is 2 to 3 times as common in women as in men and there is a familial aggregation of the disease and of serologic abnormalities. Onset is more common in the spring, especially during March.

Pathology

The main lesion is inflammation of the synovial membrane, or synovitis, with exudation (effusion), cellular infiltration (mainly lymphocytes and later plasma cells), and proliferation of granulation tissue. The thickened synovium (pannus) spreads over the cartilage and erodes it and the subchondral bone, which becomes osteoporotic. Adhesions between opposing layers of pannus may lead to fibrous ankylosis of the joint. There is also edema and cellular infiltration of periarticular tissues, especially tendons and tendon

sheaths, and foci of mononuclear cell infiltration in muscles. The most characteristic lesion is the rheumatoid nodule, consisting of a central zone of fibrinoid material surrounded by zones of large, palisaded mononuclear cells and smaller mononuclear cells. The nodules may be found in the connective tissue of almost any organ, but especially in synovial or periarticular tissue, subcutaneously.

Joints Involved

In most patients the arthritis is polyarticular and involves the small joints of the hands and feet, whether or not major joints are also involved. The joints involved, in order of frequency, are the proximal interphalangeal, metacarpophalangeal, toes, wrists, knees, elbows, ankles, shoulders, hips, temporomandibular and, rarely, cervical spine. The terminal interphalangeal joints are rarely involved except in the presence of psoriasis of the nails. The joints are usually involved symmetrically, but atypical cases occur with complete asymmetry.

Clinical Manifestations

Onset of the disease is usually insidious, with joint aching and stiffness, followed by gradual swelling, warmth, redness and tenderness. However, in about 20 percent of patients there is sudden onset of severe, multiple joint inflammation.

Local Symptoms

Joint pain, especially on motion but also at rest, swelling, stiffness after inactivity (gelling) and especially on awakening (morning stiffness), and limitation of motion due to pain and stiffness are included.

Local Signs

The typical joint presents a spindle-shaped appearance with thickening of the periarticular structures (soft tissue swelling) and atrophy of the contiguous muscle. This is best seen in the proximal interphalangeal joints. Involved joints may also be hot, red and tender. Over a period of time flexion contractures may occur, because the flexor groups of muscles are stronger. Progressive disease of the metacarpophalangeal joints leads to characteristic volar subluxation and ulnar deviation of the phalanges. Volar subluxation of the wrist seriously impairs hand function. Flexion contractures of hips and knees are also major causes of disability. The muscles of affected extremities may become severely weak and atrophied, to a greater degree than would be expected to result from disuse alone.

Systemic Signs and Symptoms

Fatigue, malaise, fever (usually low grade), tachycardia, weakness, wasting and weight loss, and mild or moderate anemia may occur. An acute, fulminating course with high fever is seldom seen in adults except as a "rebound phenomenon" following steroid withdrawal.

Extra-Articular Manifestations

The commonest of these are subcutaneous nodules, which appear over pressure joints, especially the elbow, at some time in 25 percent of patients. Lymphadenopathy is common. Splenomegaly occurs in 10 percent of patients and may be associated with leukopenia (Felty's syndrome). Vasomotor instability may occur with cold, clammy hands and feet which sweat excessively. Erythema of the thenar and hypothenar eminences, resembling "liver palms" may occur. Less common manifestations, which occur in 1 to 3 percent of patients, include pericarditis, pericardial effusion, myocarditis, pleurisy, pleural effusion and nodular pulmonary infiltrates resembling those seen in Caplan's disease of miners. Uveitis and aortic insufficiency may occur, but less commonly than in patients with ankylosing spondylitis. Other rare complications include necrotizing arteritis (resulting in skin ulcers, digital gangrene or peripheral neuritis) and systemic lupus erythematosus. Secondary amyloidosis has been found in 20 percent of patients with rheumatoid arthritis at postmortem examination, but clinical effects occur in only a few of these patients.

Albuminuria occurs in 10 percent of patients with rheumatoid arthritis. In half of these, it is due to amyloidosis, glomerulitis, arteritis or rheumatoid nodules, and in half to unrelated pyelonephritis or nephrosclerosis. Renal insufficiency may occur, but is rare.

Patients with rheumatoid arthritis are more subject to peptic ulcer than other patients and this tendency is increased when the patient takes drugs which are ulcerogenic, including aspirin, indomethicin, phenylbutazone and adrenocortical steroid.

Course

The course may be episodic or sustained. Frequently the disease begins in episodes and ultimately becomes sustained. Remissions are more common early in the disease. One-fifth of patients achieve full remission, though many later relapse. After three years of sustained disease, complete remission is rare. Patients with sustained disease develop more incapacitation and

a small proportion becomes completely incapacitated in 10 to 15 years. After 10 years of disease, 50 percent of patients are improved, including 15 percent in complete remission, 15 percent are stationary and 35 percent are worse. The manifestations and course of the disease in the aged are not significantly different than in younger patients.

Roentgenographic Manifestations

Early in the disease there is fusiform periarticular soft tissue swelling, rarefaction of underlying bone and sometimes systemic decalcification. Later there is decrease of joint space, lipping and osteophytes and punched-out areas of bone at the articular margins. Finally subluxation, flexion deformity or ankylosis may occur.

Laboratory Findings

The most important finding is the presence in the serum of macroglobulins termed rheumatoid factor in 76 percent of patients, as indicated by agglutination by the serum of latex particles coated with human gamma globulin. Rheumatoid factor is present in only 10 percent of patients with psoriatic arthritis, 3 percent of patients with ankylosing spondylitis, 21 percent of patients with systemic lupus erythematosus, 2 percent of patients with osteoarthritis or gout, and 1 percent of normal subjects. In the first few months of rheumatoid arthritis, rheumatoid factor is likely to be absent from the serum, but it usually appears during the first year of the disease. During active phases of the disease, there is also elevated erythrocyte sedimentation rate and C-reactive protein and slight leucocytosis. A mild or moderate normocytic, hypochromic anemia is common, with low serum iron but with no response to iron administration. Serum albumin is usually decreased and globulins increased, especially alpha and gamma globulins. Synovial fluid contains a high total count and proportion of polymorphonuclear leucocytes, which may contain inclusions (rheumatoid factor).

Treatment

The primary objectives are to reduce inflammation and the symptoms of inflammation such as pain, to preserve function, to prevent deformity, and to repair previous damage when necessary to restore function. The basic treatment consists of rest, physical therapy and salicylates. This suffices during most of the course of the disease in most patients. When it does not suffice, additional measures are added to the basic regimen. A candid, trusting relationship between patient and physician is important, since emotional factors often influence the course of the disease and the response to treatment and because depression and passivity may occur, especially in older patients.

Rest

Rest, both systemic and local, is helpful to most patients. The amount required depends on the activity and the severity of the disease. During acute periods, complete bed rest may be warranted, while at other times 2 to 4 hours of rest each day may suffice. Local articular rest may be provided by well-fitted, lightweight splints or shells, which should be removable to permit daily motion and exercise of the affected extremities. Emotional rest should be provided and anxiety relieved by reassurance and, if necessary, by tranquilizers or barbiturates.

Physical Therapy

Exercise is necessary to preserve and restore joint motion and muscular strength and to retard muscular atrophy. Exercises of the active-assistive type should be performed, within the limits of pain, from the onset of management. If pain lasts more than an hour after exercise, the exercise should be decreased but not discontinued. A proper balance of exercise and rest should be part of the patient's daily program until joint and muscle function have recovered. Then, a regular program of exercises to maintain general muscular fitness and reduce atrophy should be carried out.

Heat, particularly moist heat in the form of packs or bath, is helpful for its muscle relaxing and analgesic effects.

Drugs

Aspirin is the most useful drug in the management of rheumatoid arthritis and in a considerable proportion of patients is the only drug needed. It is analgesic and anti-inflammatory. In active disease, the dose is rapidly increased until pain is relieved or toxic symptoms develop (upper gastrointestinal distress, tinnitus, deafness), and a maintenance dose, at a slightly lower level, is continued more or less indefinitely. The average maintenance dose of aspirin in adults is 2 to 3 tablets (0.3 gm) 6 times a day, preferably after meals or milk to reduce gastric intolerance. Aspirin causes occult gastric bleeding in many patients and may occasionally produce or activate peptic ulceration.

In patients whose symptoms are not alleviated by aspirin, rest and physical therapy, there is no agree-

ment on which drugs should be used next or in which order. Those employed most frequently are indomethicin, phenylbutazone, soluble gold salts, antimalarial compounds, and adrenocortical steroids.

Indomethicin (50 mg 3 times a day after meals) produces improvement in approximately half of the patients with rheumatoid arthritis. Side effects of the drug include headache, vertigo, gastrointestinal symptoms and peptic ulceration.

Phenylbutazone (Butazolidin, 100 mg 3 or 4 times a day after meals) is helpful in approximately half the patients, particularly in those whose symptoms developed rapidly, though not as helpful as in patients with gouty arthritis or ankylosing spondylitis. Side effects of the drug include gastrointestinal symptoms, edema due to sodium retention (usually relieved by salt restriction), maculopapular eruption, anemia, leucopenia and thrombocytopenia. If the drug does not produce improvement after one week's administration, it should be discontinued.

Gold salts (usually 50 percent aqueous solutions of gold sodium thiomalate or thioglucoside, 50 mg intramuscularly weekly for 4 to 6 months) produce improvement in over half of the patients beginning after 2 to 5 months of administration. Some physicians then give monthly injections, but the value of this in maintaining improvement is not clear. Unfortunately, approximately one-third of patients develop toxic effects due to gold, which are severe in 5 percent. Most common are dermatitis and stomatitis. Less common are colitis and renal injury with proteinuria or microscopic hematuria. Least common (less than 1 percent) are hepatitis and bone marrow depression (anemia, leucopenia, thrombocytopenia). The toxic effects of gold respond to the prompt administration of adrenal corticosteroid and dimercaprol (BAL), except that severe bone marrow depression may be irreversible and fatal.

Chloroquine (Aralen, 250 mg a day) or *hydroxychloroquine* (Plaquenil, 200 mg twice a day) produces improvement in over half the patients beginning after 1 to 6 months of daily administration. Side effects of these drugs appear in up to 50 percent of patients after this period of administration. These include skin lesions, loss or blanching of hair, anorexia, nausea, vomiting, peripheral neuropathy or neuromyopathy, headache or, rarely, bone marrow depression. Corneal changes may occur which may be asymptomatic or manifested by halos around lights, fuzziness of vision and loss of corneal sensitivity. These changes are reversible with cessation of the drug. However, retinopathy occurs in 1 per 1,000 to 2,000 patients and is irreversible. Patients taking these drugs must be examined by an ophthalmologist every 3 months. Some physicians consider the risks of the drugs too great to warrant their use.

Adrenal corticosteroids have an impressive anti-inflammatory effect and may be used for short periods of time in patients in whom other measures have failed to relieve pain and delay progress of joint or systemic disease. The initial and maintenance dose should be as low as is needed to produce and maintain moderate symptomatic relief (usually 10 to 20 mg prednisone a day in 2 to 4 divided doses), and should not be increased to the dose necessary to completely relieve pain.

Clinical improvement occurs in three-fourths of patients, usually beginning within hours and reaching a maximum response in 3 to 4 weeks. In nearly half the patients, the clinical improvement may then diminish despite continuation of steroid administration. While the steroids suppress inflammation and acute manifestations of the disease, they do not prevent joint destruction and deformities. Furthermore, unless the disease has entered into natural remission, discontinuation of steroid is followed by return of signs and symptoms that were present before steroid was initiated. If the drug is withdrawn rapidly, there is often a rebound, with more severe signs and symptoms than prior to treatment. Therefore, a gradual and prolonged tapering of dose is necessary when the drug is discontinued, usually at the rate of 1 to 2.5 mg weekly or biweekly.

The side effects of corticosteroids are similar to those of spontaneous Cushing's disease, except that hypertension is much more common and more severe in the latter. The milder side effects include truncal obesity, moon facies, acne, ecchymosis, hirsutism, mild insulin-resistant diabetes, and euphoria. More serious side effects, which usually require discontinuation of steroid, include peptic ulcer, osteoporosis, psychosis, myopathy, cataracts and increased susceptibility to infection.

It has been suggested, though not proved, that patients with rheumatoid arthritis may be more prone to the development of peptic ulcer, particularly gastric, than other patients receiving corticosteroids. Therefore antacids should be administered prophylactically. Patients with rheumatoid arthritis may also be more

prone to develop osteoporosis, perhaps owing to their inactivity, and also to develop the even rarer complication of aseptic necrosis of the femoral or humeral head. Instillation of corticosteroid into acutely inflamed joints produces temporary relief of symptoms, but repeated injections may introduce infection or cause changes resembling the Charcot joint.

Once the arthritis has come under control, repeated efforts should be made to reduce the maintenance dose of steroid and to discontinue the drug. After several months of steroid administration, the harmful side effects of the drug are usually more significant than the benefit provided. Therefore, the long-term management of the disease relies on other measures, particularly rest, physical therapy and aspirin, with steroids being reserved for use during as brief a period as possible in patients who have not responded to other measures.

Surgery

Surgery is needed in a small number of patients. Chronically hypertrophied synovia may be removed from knees, wrists and metacarpophalangeal joints, but the value of synovectomy is still under study. Painful, plantar subluxed metatarsal heads may be resected. Occasionally fusion of the wrist or elbow in a useful position may be necessary to stabilize a useless joint. Prosthetic joint replacements are being developed with metallic hinges for fingers, metacarpophalangeal joints and knees.

PSORIATIC ARTHRITIS

Eight percent of patients with psoriasis have arthritis at some time in the course of the disease. In half of these, the arthritis is a distinct type termed psoriatic arthritis. In the remainder the arthritis is classical rheumatoid arthritis, osteoarthritis or gout. Psoriatic arthritis differs from rheumatoid arthritis in several respects:

The distal interphalangeal joints of the fingers and toes are most commonly involved, and psoriatic lesions may be found in the adjacent nails. The cervical spine, hips and sacroiliac joints may also be affected, but asymmetrical involvement is more common than in rheumatoid arthritis.

Exacerbations and remissions of the joint manifestations may occur synchronously with those of the skin. Remissions tend to be more frequent, rapid and complete than in rheumatoid arthritis.

Subcutaneous rheumatoid nodules are absent.

Rheumatoid factor is present in the serum in only 10 percent of patients.

Radiologic examination shows involvement of the distal interphalangeal joints and resorption of terminal phalanges.

Ankylosis of the interphalangeal joints or severe osteolysis progressing to arthritis mutilans may occur.

Treatment

Treatment is similar to that for rheumatoid arthritis, with the addition of measures for psoriasis. Local applications include chrysarobin, dihydroxyanthranol, crude coal tar with ultra-violet light, and corticosteroid. Systemic medication for psoriasis includes corticosteroid, especially triamcinolone, and methotrexate for severe, uncontrollable disease.

ANKYLOSING SPONDYLITIS

Ankylosing spondylitis is a chronic and usually progressive disease of the sacroiliac joints, the synovial joints of the spine, and the adjacent soft tissues. The disease differs from rheumatoid arthritis in several respects:

Eighty to 90 percent of patients are male. The age of onset is usually between 16 and 40 years and especially between 17 and 25 years. Activity of the disease usually decreases after the age of 50, but limitation of movement of the spine persists.

Ligamentous calcification and ossification occur in later stages.

Subcutaneous rheumatoid nodules are absent.

Rheumatoid factor is present in the serum in only 3 percent of patients.

Gold therapy, which produces improvement in half of the patients with rheumatoid arthritis, has no effect on ankylosing spondylitis. On the other hand, roentgen therapy, which has no effect on rheumatoid arthritis, produces symptomatic relief in areas recently involved by ankylosing spondylitis.

Clinical Manifestations

The onset is usually insidious, with episodes of low backache, stiffness and sciatic pain which last a few days at a time and subside. Later, local symptoms become more persistent and systemic symptoms such as fatigue, anorexia, weight loss and low grade fever may occur. Occasionally thoracic girdle pains or radicular pains in the costovertebral angle, abdomen or inguinal region may occur. Tenderness over the spine and sacroiliac region is frequently present.

Involvement of the lumbar spine produces straightening of the lumbar spine, pain on motion, limitation of motion ("poker back"), paravertebral muscle spasm and anterior stoop. Involvement of the thoracic spine produces thoracic girdle pains, chest pain on deep inspiration, diminished chest expansion and thoracolumbor kyphosis. Involvement of the cervical spine causes limitation of motion in all directions and forward protrusion of the head.

Almost one-fourth of patients develop involvement of peripheral joints, especially shoulders and hips, indistinguishable from rheumatoid arthritis. The extra-articular manifestations of ankylosing spondylitis are similar to those of rheumatoid arthritis; in fact, uveitis, aortic insufficiency and pulmonary fibrosis are even more frequent.

Roentgenographic manifestations are characteristic. Changes in the sacroiliac joints are the earliest and most diagnostic. They consist of bilateral sclerosis and later ankylosis. Similar changes occur in the spinal apophyseal joints, but are less constant early in the disease. Later, calcification and ossification of the annulus fibrosus and paravertebral ligaments may occur ("bamboo spine").

Treatment

Treatment is similar to that in rheumatoid arthritis, except that gold is ineffective and corticosteroids are less effective than in rheumatoid arthritis. Local roentgen therapy (600 to 800 roentgen units in divided doses) reduces pain, stiffness and tenderness, especially in recently involved areas, but is inadvisable or, at best, reserved for patients with severe symptoms who do not obtain relief from other measures, because of the possible increased incidence of leukemia in patients so treated.

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METABOLIC DISORDERS OF THE SKELETON IN AGING

By

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OSTEOPOROSIS

Osteoporosis, a disorder characterized by a decrease in both mass and density of the skeleton, occurring principally during the middle and later years of life, is the most prevalent metabolic disorder of bone. Although this condition is usually asymptomatic, because of the resulting structural weakness of the bone predisposing to fracture, this disorder is of considerable potential importance in morbidity to millions of individuals over the age of 50 throughout the world.

In recent years, Albright's concept (1940), that osteoporosis of the aging individual was due to osteoblastic failure consequent to decline in production of gonadal hormones, has been strongly challenged and significantly revised (Lutwak, 1963–a; Whedon, 1968). In contrast to the classical concept which presupposed impaired formation of protein matrix of bone, the specific etiologic factor of calcium deficiency has been proposed (Whedon, 1959; Nordin, 1962). The current concept places the emphasis on an increase in bone resorption as the primary mechanism in this disease, rather than failure of new bone formation.

Osteoporosis may be defined from the point of view of clinical and laboratory findings as a disease of too little bone. The existent bone tissue is normal in composition, with normal proportions of calcium, phosphorus, water and organic material. The amount of bone tissue present, however, is less than normal, resulting in skeletal volume which is markedly diminished from normal. Thus, osteoporosis may be considered as atrophy of an organ, that is, reduction in the amount of bone with no alteration in its chemical composition.

Clinically, osteoporosis is characterized by: no symptoms at all, or by mild to moderate discomfort, usually in the back; increased incidence of fractures of bones such as the pelvis, femur and spine; a gradual loss of height due to vertebral fractures; and marked radiolucency of the bone on X-ray.

Published estimates of the incidence of the disease are based on different criteria for severity, ranging from the simple presence of radiolucency on routine X-ray to the finding of at least one fracture of the vertebrae and marked loss of height. Nonetheless, various estimates agree quite closely in arriving at a figure for the incidence of this disease. With the growth in numbers of the aging population, the incidence of osteoporosis of the spine has become significant in statistics of public health and general morbidity. Various surveys in old age homes under medical care have shown incidences of osteoporosis ranging from 15 to 50 percent of the population over the age of 65 years, with a mean of about 30 percent. Extrapolating from recent data concerned with incidence of disease and distribution of age in the general population, one may arrive at an estimate of approximately 10 percent of the population, or about 10 million individuals in this country over the age of 50 with a sufficient degree of osteoporosis to produce vertebral fracture. Obviously, this is a condition demanding more intense concern, particularly in the areas of prevention.

Osteoporosis is a stereotyped response of the skeletal system to a variety of stimuli and is therefore seen in many different disease processes. These include:

1. Various endocrinopathies involving the thyroid, adrenal pituitary and parathyroid glands.
2. Disorders of immobilization, such as result from surgical trauma, rheumatoid arthritis, osteomyelitis, and long-term bedrest.
3. Disorders of nutrition, either primary or secondary to gastrointestinal disease.
4. So-called postmenopausal, senile, idiopathic osteoporosis, where no other specific disease process may be implicated, which is the largest group by far.

Osteoporosis secondary to a specific pathologic process may be arrested and, in occasional instances, reversed by appropriate therapy of the underlying condition. However, there remains the group in which no specific etiologic mechanism has heretofore been implicated and thus no rational treatment defined. This is the fourth group listed above.

Characteristically, osteoporosis of this category—senile, postmenopausal or idiopathic—is a condition seen primarily in women over the age of 50. Various population surveys have indicated a sex incidence of 4 to 1 of females over males. The disorder involves

primarily the lumbar and lower thoracic vertebrae. Radiologically, generalized radiolucency of the spine is seen with frequent appearance of fractures of the cortices of the vertebrae, the presence of Schmorl's nodes in the intervertebral spaces and characteristic codfish vertebrae. Histologically, the bone is normal, but there is much less bone present in the areas examined. The ratio of mineralized to nonmineralized material is normal, unlike the picture seen in osteomalacia where there is an excess of organic matrix. On the microradiographic scale of observation, the characteristic appearance is that of undermineralized osteones with an increased number of areas of bone resorption. Biochemically, no specific abnormalities are apparent. Serum calcium and phosphorus may be normal or low. In occasional patients, hypercalciuria may be seen in the early phases of the disorder but, generally, by the time fractures have occurred, urinary calcium excretion is very low.

A consideration of the normal mechanisms of bone physiology and metabolism is essential to the understanding of the pathogenesis of this disorder as well as to attempts at prophylaxis and therapeutic measures. Ninety-nine percent of calcium is present in the bone as calcium hydroxyapatite crystals. The remaining 1 percent is in the circulating calcium pool, primarily in extracellular fluid. The circulating calcium is present as ionized calcium, as well as in the form of protein-bound calcium.

The ionized calcium concentration must be maintained within relatively narrow limits for the proper functioning of neuromuscular irritability, cardiac contractility, blood clotting, and membrane permeability. This concentration in man is approximately 2.5 mEq per liter. Homeostatic control of the concentration of this ion involves the kidney, the gut, parathyroid hormone, calcitonin, as well as other endocrine systems. Normally, the calcium in the extracellular pool participates in various obligatory processes which lead to constant losses from this compartment. Glomerular filtration and tubular resorption result in urinary excretion of calcium which may range from 50 to 200 milligrams per day, with relatively constant values for each individual. Calcium is normally secreted into the gastrointestinal system in bile and pancreatic juices and passes through the intestine, from which a portion is reabsorbed and the majority excreted in the feces. This endogenous secretion of calcium is on the order of 150 milligrams per day (Heaney and Skillman, 1964).

In the female, there are several additional routes of loss of calcium from the metabolic pool. Calcium is withdrawn to provide skeletal mineral for the fetus, amounting to as much as 20 grams per pregnancy. During lactation, calcium is secreted in the milk at a rate of as high as 1 gram per day. In addition, varying amounts of calcium may be lost in the sweat. The magnitude of this loss depends on the degree of activity and ambient temperature. Under conditions of comfortable, air-conditioned room temperatures, as well as under conditions of relatively heavy exercise, these losses rarely exceed 20 milligrams per day (Gitelman and Lutwak, 1963; Lutwak et al., 1969–a).

Since for the normal physiologic functioning of the organism the concentration of calcium in the circulating metabolic pool must be kept constant, and since certain fixed losses of calcium occur in the course of normal metabolic patterns, the mechanisms for introduction of calcium into the circulating pool become important. Calcium may enter the organism only by absorption of dietary calcium from the gut. Serum calcium concentration rises slightly, but significantly, immediately after the ingestion of large amounts of dietary calcium (Kerr et al., 1962; Taylor and Lutwak, unpublished). This rise is transient since calcium is removed from the pool by mechanisms of excretion and by deposition into the skeleton.

In addition, if the sources of dietary calcium are inadequate, or if absorption of calcium from the gut is impaired, calcium may enter the metabolic pool from the stored mineral within the skeleton. The skeletal calcium is present in varying degrees of availability. Bone mineral is deposited continually in newly formed osteones by osteoblastic cells. Simultaneously, and as required by demands from the metabolic pool, bone is resorbed from skelton by the action of osteoclastic cells and by direct resorption or osteolysis.

Mechanical stress and gravitational forces stimulate osteoblastic activity; resorptive activities continue in the absence of mechanical stress under normal circumstances. Parathyroid hormone stimulates resorption as well as bone formation. Calcitonin inhibits resorptive activity. Adrenal corticosteroids have been shown in some species to inhibit both bone formation and resorption, but formation to a greater extent than resorption. Thyroid hormone, on the other hand, has been found to stimulate both bone formation and bone resorption, but will affect bone resorption to a greater extent than formation.

In the absence of specific abnormality of endocrine

function, renal function or gastrointestinal function, and when dietary calcium intake is adequate, the constant losses from the body by way of the urine, feces, sweat, lactation and fetal development are replaced by absorption of the dietary calcium, without demands upon the skeleton. If, however, the losses from the body by various routes are increased beyond the amount which is absorbable from the diet, or if the amount of calcium available in the diet is less than that normally excreted from the pool, the calcium necessary to maintain homeostasis must be obtained by resorption from the skeleton. When the imbalance between losses and absorption of dietary calcium continues long enough, the skeleton will then, of necessity, contain a diminished amount of mineral and will, by definition, be osteoporotic.

From these considerations it may be seen that in the aging individual, osteoporosis can result from inadequate dietary intake of calcium over the course of adult lifespan; from impairment of absorption of calcium; or from excessive losses of calcium by various excretory mechanisms. In each of these situations, bone mineral will be lost by the process of increased bone resorption.

Various types of evidence have accumulated as the result of recent investigations by various laboratories supporting this concept. From isotope kinetic studies, it is apparent that patients with osteoporosis show normal or slightly elevated rates of bone formation but markedly increased rates of bone resorption (Lutwak and Whedon, 1963–b). Microradiographic studies have further indicated the presence of increased areas of resorption in bones of patients with idiopathic osteoporosis (Jowsey, et al., 1965; Frost, 1961).

The role of dietary calcium in the human adult has too often been ignored as a possible etiologic agent in disease because of the assumption that both animals and man can maintain calcium balance over wide ranges of calcium intake and that adaptation to low dietary intakes through decreased urinary excretion occurs consistently. In fact, a positive correlation between calcium intake and calcium balance has been shown by several investigators in individuals without disease. In addition, in the long-term studies of Malm (1958), normal males on high calcium intake tended to maintain positive balance over many months. More importantly, Malm also demonstrated that, although most individuals were able to reduce urinary calcium excretion on low dietary intakes of calcium, a significant number could not adapt, but remained in negative calcium balance when intake was increased.

In several animal species it has been clearly shown that bone density is directly related to dietary calcium intake. In rats (Gershon-Cohen and Jowsey, 1964), dogs (Krook, 1957), cats (Krook et al., 1963), monkeys (Krook and Barrett, 1962) and horses (Krook, 1968), a low calcium diet produces osteoporosis (not osteomalacia) and, more significantly, this condition can be reversed by raising the dietary calcium (Henrikson et al., in press). Recent data have demonstrated that in the course of the development of osteoporosis in experimental animals, a mild degree of hypertrophy of the parathyroid glands, leading to increased bone resorption occurs (Gershon-Cohen and Jowsey, 1964; Krook, 1957; Krook et al., 1963; Krook and Barrett, 1962; Krook, 1968; Henrikson et al., in press). Indirect evidence from studies with bulls has further demonstrated that high dietary calcium stimulates the production of calcitonin (Krook et al., 1969), which has been demonstrated to inhibit bone resorption.

In the human species, dietary evidence is much less convincing because of difficulty in obtaining reliable long-term data. Retrospective diet histories, though notably inaccurate, have suggested a relationship between lifelong calcium intake and bone density. In most studies, comparison of the calcium intake of groups of patients with osteoporosis and that of individuals of the same age without osteoporosis suggests a lower customary intake among the osteoporotics (Lutwak and Whedon, 1963).

A number of metabolic balance studies have demonstrated that administration of high calcium intake to patients with osteoporosis results in significant storage of mineral, which is maintained over several weeks or months (Lutwak and Whedon, 1963–a; Schwartz et al., 1965). In these studies, the intake of calcium required to produce significant storage at least (100 milligrams per day) was generally greater than 1.5 grams per day. Significant levels of storage were maintained in many subjects for as long as 2 years, the balance becoming less positive as the high intake was continued. Since 99 percent of the calcium in the body is stored in the skeleton and since these increased calcium intakes do not result in measurable increases in blood or soft tissue calcium content, any storage of calcium over an extended period of time must be within the bone, replenishing the diminished stores in the osteoporotic subjects. Once vertebral fractures have

occurred, bone height cannot be expected to increase; eventually equilibrium will be attained when the remaining bone has become adequately calcified.

Over the past 12 years, the author and his associates have studied a series of unselected, though generally severe, cases of osteoporosis (Lutwak and Whedon, 1963–a; Lutwak, 1964–a; 1964–b). Most patients were studied for at least 3 weeks of balance at each level of dietary calcium varying between 150 and 2,400 milligrams of calcium daily. Metabolic balances were calculated after a patient had been on a particular diet for several weeks to 6 months.

The results have indicated that nearly all patients were in negative balance at their customary intake of the previous years; that in the majority of the patients this customary intake was less than 400 milligrams per day; that improved storage of calcium resulted in about 75 percent of the patients as dietary intake was increased; and that the calcium intake at which balance was achieved varied from 500 to 1,600 mgm per day with a mean at approximately 1,000 mgm, suggesting a higher than normal mean calcium requirement for individuals who develop osteoporosis (recent National Research Council Recommended Daily Allowances have been set at 800 mgm. per day). Generally, phosphorus balances were in parallel with calcium balances, further suggesting that the mineral stored was in the form of bone. At the very high calcium intakes, a disproportionate storage of calcium in relation to phosphorus was noted, as might be expected, from the range of calcium: phosphorus ratios obtainable in bone analyses.

Of more pertinent clinical significance are recently reported observations that significant increases in bone density have been observed in some patients treated for a year or longer with calcium supplements (Nordin and Smith, 1964). Techniques for determination of bone density are improving to the stage where such sensitivity and reliability are just becoming available and further data should be forthcoming within the next few years (Cameron and Sorenson, 1963).

Of special interest and importance are the 25 percent of the patients who did not show significant improvement of calcium balance when dietary calcium was increased. It has been suggested by several laboratories that a group of patients exists in which malabsorption of calcium may play a role in the development of osteoporosis (Nordin, 1960; Lutwak, 1969–b). Two such categories have thus far been defined.

In many patients, subclinical steatorrhea, less than 7 grams of fat per day, has been noted without any concomitant evidence of osteomalacia. Serum calcium, phosphorus and alkaline phosphatase have been within normal limits. In these individuals, calcium absorption has been shown to be decreased and can be brought to normal by treatment with slightly higher than physiologic levels of Vitamin D (Lutwak and Whedon, 1963). The absorption of dietary calcium is inversely related to the level in the diet, that is, the higher the amount of calcium the lower the percentage absorbed (Lutwak, 1969–b; Nicolaysen, 1943). However, in a group of osteoporotic patients, it has been noted that calcium absorption remains low even in the presence of markedly reduced dietary levels, suggesting that specific defects in calcium absorption may occur (Lutwak, 1969–b; Riggs, et al., 1967). Such defects may be theoretically on a genetic basis, since it has been shown that the absorption of calcium may be related to a specific protein of the gastrointestinal cell (Wasserman and Taylor, 1968).

Another significant link between gastrointestinal function and calcium absorption has been indicated in finding an association between intestinal lactase deficiency and osteoporosis (Birge, et al., 1967). Nine of 19 patients with osteoporosis were found to have impaired oral lactose tolerance tests, as well as decreased levels of lactase activity in specimens obtained by jejunal biopsy. These observations suggest that some patients may develop osteoporosis through long-term dietary calcium restriction, voluntarily instituted to avoid the symptoms of lactase intolerance. It has further been demonstrated that in diarrheas of various etiology, presumably including lactose intolerance, absorption of various nutrients is impaired, including that of fat and of calcium.

The other mechanism suggested for development of osteoporosis has been increased losses of calcium from the body. In various studies of patients with osteoporosis, no abnormalities of endogenous intestinal secretion of calcium have been described.

Skin losses of calcium have invariably been shown to be relatively low when carried out under control conditions of collection and analysis. Thus, the only major route of loss is through the kidney. Approximately 20 percent of patients with osteoporosis have been shown to have persistent hypercalciuria even on low intakes of dietary calcium; the urinary losses may contribute to the pathogenesis of this disease in these individuals.

Particularly in the aging population, various regimens adopted for therapy of other diseases may increase the degree of osteoporosis or actually produce this condition secondarily. The use of corticosteroids for the treatment of various chronic diseases such as rheumatoid arthritis, chronic allergy, etc. will increase osteoporosis by inhibition of bone formation and an increase in renal clearance of calcium (Whedon, et al., 1961; Lutwak, 1964–c). This is a hazard that must be borne in mind in instituting such therapy.

Recently, heparin has been implicated in the production of osteoporosis. In humans the data are not clearly convincing. Six of 10 patients on extended heparin therapy (Griffith, et al., 1965), at doses above 15,000 units per day, were found to develop fractures of the vertebrae or ribs, whereas more than 100 patients on doses below this had none. *In vitro* studies in rats demonstrated a stimulation of the release of collagenase from lysosomes of bone cells by heparin, resulting in an increase in bone resorption. Chronic heparin administration to rats produced a marked increase in osteolytic activity of bone cells and retarded callus formation after fracture.

Bed rest and long-term immobilization are among the consequences of heart disease and cerebral vascular accidents in the aged. It has been clearly demonstrated that immobilization will result in increased calcium losses from the body with the inevitable production of osteoporosis (Deitrick, et al., 1948; Heaney, 1962). This is another possible contributing factor to osteoporosis in the aging individual.

In view of the many possible mechanisms for the development of osteoporosis, it is not surprising to find a wide range of suggested therapeutic regimens. The criteria for the effectiveness of therapy in well-established osteoporosis are few and poor. Pain relief is frequently a placebo effect and therefore an inadequate end point. Radiographic remineralization of osteoporotic spine is difficult to detect because of the relative slowness of the processes involved and the relative insensitivity of such techniques. The techniques for estimation of the degree of osteoporosis based on examination of biopsy material are not sufficiently standardized to be used for evaluation of therapy. Metabolic balance studies, which may provide objective evidence for retention of calcium, are difficult to carry out and must be prolonged to be of significance. Direct bone densitometric measurements by gamma ray spectrometry have just become available and have not as yet been sufficiently standardized to be of general value.

Thus, in the absence of simple criteria for effectiveness of therapy, the physician faced with the osteoporotic patient demonstrating loss of height, vertebral fractures, increasing disability and pain, must, at the present time, select the multifaceted approach to the problem. When a specific etiology is demonstrably the primary mechanism in a patient, the choice of therapy is relatively simple. Discontinuation of drugs affecting the skeletal system when possible, or correction of an underlying disorder, can be carried out. In the majority of patients, however, the physician must choose a combined program tailored to the needs of the patient and adjusted as the patient responds or does not respond, as determined by cessation of loss of height, incidence of fractures, etc. over 6 months to yearly intervals.

At the base of any constructive therapeutic regimen, a program of optimal nutrition and appropriate physical activity should be instituted. Immobilization should be avoided, except when absolutely necessary subsequent to acute vertebral fracture. When fracture does occur, 2 to 4 weeks in bed in slight hyperextension may be necessary in order to obtain fixation of the damaged vertebrae and reduction of pain and associated muscle spasm. If, however, the patient with back pain is ambulatory, the pain may be due to spasm of paravertebral muscles which have been forced to take over some of the weight-bearing function from a weakened spine; thus, a properly fitting Taylor brace may be useful for daytime support and permit adequate ambulation. Physical medicine should be used as needed to increase activity and relieve pain. Social medicine, through the services of the case worker and psychiatrist, if necessary, is utilized to provide the patients with the necessary incentives and encouragement to sustain an active life, despite chronic and progressive disability.

Based on the various evidence presented, nutritional therapy is indicated. Primary in this consideration is an abundant intake of calcium. Since many who develop osteoporosis conserve calcium poorly and require relatively large amounts of this mineral for balance, efforts should be made to provide calcium to at least the level of 1.5 grams per day, preferably higher. Whole milk, or skim milk if there is a concern for fat or caloric level, provides approximately 1 mgm. of calcium per milliliter and is the most efficient source. Some patients will be intolerant of the lactose content of this large quantity of milk which then may be replaced with buttermilk or other forms of fermented

milk. In addition, many patients will require further supplements of calcium to provide the adequate level. These may be given in the form of calcium lactate (13 percent calcium by weight), gluconate (9 percent), phosphate, glycerophosphate, or carbonate. Current studies in which the dietary ratio of calcium to phosphorus is being manipulated suggest the possibility that in some patients added phosphate may improve calcium balance (Lutwak, 1963–c; Goldsmith, et al., 1969). Thus phosphate salts of calcium may be preferable to provide the optimal 1 to 1 ratio of calcium to phosphorus.

It further appears reasonable to recommend that adequate protein be provided in the diet, since protein is required in the formation of organic matrix as part of the continual turnover of the skeleton. Nitrogen and calcium balance are not closely correlated, however, and positive nitrogen balance is not essential for calcium storage. A requirement for increased dietary protein in the treatment of osteoporosis cannot be recommended at this time.

Vitamin D is indicated in patients with evident malabsorption, whether or not characteristics suggestive of associated osteomalacia are present. Vitamin D in doses of 5,000 and 10,000 units per day has been useful in improving mineral retention in some patients without clinical steatorrhea.

Recent evidence has been put forth that dietary fluoride should be adequate for optimal utilization of dietary calcium (Bernstein, 1966). There is no indication at present for the use of pharmacologic levels of fluoride in the treatment of osteoporosis; however, the presence of fluoride at a level of 1 part per million in the drinking water probably has a beneficial effect in the skeletal retention of mineral.

Despite the lack of any evidence to date for a role of either estrogens or androgens directly in bone formation, it has been demonstrated that estrogens, particularly, will decrease urinary calcium in patients with hypercalciuria. Furthermore, the addition of physiologic doses of estrogen to the regimen in postmenopausal women will generally lead to an overall improvement of affect, well-being, and appetite, and therefore should be included as part of the total regimen.

Careful consideration of the mechanisms involved in osteoporosis leads to the unfortunate conclusion that osteoporosis is difficult to treat and impossible to cure and that, therefore, the most effective measures to be taken are in prevention. Prophylactic measures should be put into effect well before the disorder becomes established and fractures have occurred.

On the basis of the information currently available, the most important preventive measures are the following:

1. Adequate calcium intake, preferably in excess of 0.8 to 1.0 grams daily in association with adequate dietary levels of protein and other nutrients, including Vitamins C and D.
2. Detection and treatment, if possible, of malabsorption and the administration of Vitamin D in such cases.
3. Detection and treatment, if possible, of any associated conditions producing excessive loss or high turnover of calcium.
4. Gonadal hormonal replacement in women beginning at, or shortly before, menopause with cyclic, sequential treatment to prevent excessive urinary losses of calcium and to improve psychic status.
5. Maintenance of adequate physical activity throughout life, compatible with general physical health and locomotor ability.

OSTEOMALACIA

Osteomalacia is a relatively rare metabolic disorder of the skeleton in Western society. Osteomalacia, also known as "adult rickets," is characterized by the presence of poorly mineralized osteoid matrix within the skeleton. The total volume of bone may not be decreased, but the amount of mineral is diminished. Biochemical findings include low values for serum concentrations of calcium and phosphorus and elevated alkaline phosphatase. Urinary excretion of calcium is extremely low, approaching zero.

Osteomalacia is invariably due to a deficiency of Vitamin D, either primary or secondary.

Primary Vitamin D deficiency is rare and probably nonexistent in the adult population, since the requirement for the adult is sufficiently low that it is obtainable by the action of sunlight, even in Northern climates or from relatively minor sources in the diet. Combined osteomalacia and osteoporosis may be seen in some individuals who have been inadequately nourished and confined away from outdoor exposure for long periods.

Secondary osteomalacia is relatively more common. This is the result of generalized malabsorption including malabsorption of Vitamin D. It has been described in patients with massive steatorrhea secondary to gas-

trointestinal disease, such as tropical sprue, gluten sensitive enteropathy, various drug-induced enteropathies, and intestinal tuberculosis. Therapy in such conditions requires the use of Vitamin D parenterally, which usually results in a prompt response with elevation of serum calcium and phosphorus and remineralization of the skeleton.

OSTEITIS DEFORMANS

A relatively common, but usually undiagnosed, disorder, osteitis deformans, or Paget's disease of the bone, may also be considered a metabolic disorder (Nagant de Deuxchaisnes and Krane, 1964). When the disease is generalized, the patient presents a characteristic appearance of thickened bones of the skull, deformities of the long bones, such as the humerus, femur and tibia, and has occasional pain. More commonly, however, the disorder is localized, limited to one area of a bone, and may not be diagnosed, except inadvertently.

The disorder is characterized histologically by the appearance simultaneously of areas of massive degrees of bone resorption and rapid new bone formation in a non-organized fashion. Pain may or may not be a characteristic of the disease and generally is not directly related to the degree of involvement. Because of the aberrant pattern of new bone formation and the increased areas of bone lysis, the initial diagnosis may be mistakenly that of malignancy primary or metastatic to the bone.

The radiographic appearance, however, is quite characteristic and, especially when the disorder is generalized, can be readily differentiated. Surveys from various autopsy series suggest an incidence of approximately 4 percent of the general adult population (Pygott, 1957). The more severe generalized disease is much less common. A significant hazard of sarcomatous changes has been reported in the generalized type of Paget's disease (Freydinger, et al., 1963).

Serum chemistries are generally characteristic. Serum calcium and phosphorus are normal and alkaline phosphatase values are markedly elevated, considerably in excess of those seen with any other disease.

Because of the cyclic nature of this disorder, with periods of excessive activity of either the formation or resorption phases followed by periods of quiescence, the evaluation of therapeutic measures has been difficult. Among those recommended have been the use of anabolic steroids such as androgens (McGavack, et al., 1961), as well as the use of aspirin (Maurice, et al., 1962) and of corticosteroids (Albright and Henneman, 1955). Beneficial effects have been reported with all three.

Attempts have also been made to inhibit bone resorption by the use of large intakes of dietary calcium. The most effective therapy to date has been the use of large amounts of fluoride by mouth, approaching toxic doses (Nagant de Deuxchaisnes and Krane, 1964; Rich and Ensinck, 1961; Purves, 1962). By means of radioactive calcium studies, it has been shown that osteitis deformans is characterized by extremely high rates of bone turnover. The administration of sodium fluoride in doses of 40 to 60 milligrams per day, sufficient to produce severe gastric irritation, has been shown to reduce bone turnover rates and inhibit the resorptive phase of Paget's disease for long periods of time. At present, there are no acceptable hypotheses for the etiology of this disorder and thus therapy must be empirical.

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INJURIES TO THE SKELETAL SYSTEM OF OLDER PERSONS

By

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INTRODUCTION

Response to injuries to the skeletal system in elderly people often differs considerably from those that occur in other age groups. The immediate reaction to injury, the healing process, morbidity, mortality, complications and end results are often quite dissimilar between the old and young. Though many similarities do exist and principles of treatment are generally the same, special discussion of the differences in particular would appear to be helpful.

It is an accepted fact that certain structural and physiological changes take place in the aging process and that the older a person becomes, the more likely he is to suffer from multiple medical illnesses. In addition, the older person is more likely to be confronted with changes which result in social and economic burdens which add immeasurably to his physical problems.

Kohn (1963) has defined the aging process as "one that occurs in all members of the population; it starts or occurs more rapidly after maturity is attained, and is progressive and not reversible under usual physiological conditions. Such a process may be either harmful or of little significance." He further states that "human aging is characterized by a logarithmic increase in death rate due to a large number of diseases; by decrease in efficiency of homeostatic mechanisms and by chemical and physical changes at tissue, cell and molecular levels."

The process of aging can also be defined as a progressive decline in all the vital capacities of the organism that terminates finally at death. Some people appear old beyond their years and others remain much younger in appearance than their age would indicate Advancing age cannot be measured solely on a chronological basis; many factors are involved which indicate a contrast between chronological and physiological age. Aging indicates many things, including loss of certain cells, atrophy of certain tissues, decline in certain functions, and is also represented by the accumulation of certain diseases, partly because of the physiological changes characteristic of aging. The individual in the last decades of his life is often going to be affected by these physiological and medical changes.

A majority of elderly patients die from arteriosclerotic heart disease or vascular disease or both, and those who survive these will die mostly from malignant neoplasms, accidents or respiratory infections. Those patients who sustain an injury will frequently have one or more medical problems associated with it. The existence of such medical problems is one of the major reasons why the progress and prognosis of injury of the older patient may be very different from the younger one.

PATHOPHYSIOLOGICAL CONSIDERATIONS

Those pathophysiological changes relevant to the skeletal system that take place with human aging are important enough to the problem of injury to justify brief comment.

Collagen, which constitutes about 40 percent of body protein, is most important in any consideration of injuries to the skeletal system. Not only does it serve as a matrix upon which minerals are deposited to give bones their hardness, but is very definitely related to the healing of soft tissues which surround bones and joints. Changes which occur in collagen with aging have been studied intensively. Collagen fibers are known to increase in size and become irregular in shape due to development of cross linkages between their constituent tropacollagen molecules. Elasticity of the collagen fiber thereby is diminished and it becomes thickened and less mobile. These are important factors when one considers the mobility of joints following injuries and the strength of repair at various times during the healing process. The structures that are important therefore in the function and health of the skeletal system, including bone, joints, muscle, cartilage and skin, may show changes with aging that not only predict the type and location of injury, but also influence the reactions to stress and surgery which lead to healing.

There is a progressive decrease in total bone mass throughout later life, though the reason for this is not clear. It has been shown that bone density is low in the growing years, increases and plateaus during middle age, and falls again in old age. There is an irregularity of trabecular pattern in the older patient which is in

marked contrast to the young adult. The occurrence of osteoporosis and osteomalacia is common in the elderly person, with many theories having been proposed as causes. At the present time, it is felt that in the aged there may be adequate bone formation, but that bone resorption is considerably increased resulting in less bone mass. The possibility that calcium and/or protein intake are low or that these nutrients are poorly absorbed in the older patient is also still under study. It appears likely that reduction of bone mineral in those of advanced age is rooted in multiple causes.

Despite the foregoing, it is important to realize that while the older individual's bones may fracture more easily than those of the young, they also have a tremendous potential to heal and do so very often with a voluminous amount of callus formation. Except for a few isolated fractures where mechanical factors may be involved, almost all fractures heal and they often do so rapidly.

GENERAL CONSIDERATIONS IN TREATMENT OF THE AGED

Even though much is said about the characteristic changes that take place with aging, one must realize that every degree and variation may occur. In general, those who are responsible for the care of the elderly find that while the response to injury may be different from that in the young, it is often a good response when the process is understood and precautions are taken. Much progress has been made in recent years in the care of people of all ages, and today more elderly patients are surviving injury to make satisfactory recovery to preinjury status than ever before. It must be remembered, however, that because of the many changes that take place with aging, realistic treatment should be based on the objective of restoring the patient to his condition prior to injury. It is unwise to initiate a program in the hope that a state of health can be obtained in the older patient beyond that which existed before.

Social and economic factors are of great importance in the care of the aged. These persons, for the most part, are living out their last years either alone or with a relative or friend, and often require varying degrees of assistance, both physical and economic. To most elderly people a substantial skeletal injury is often viewed as a major catastrophe. It poses a burden not only to the patient but also often makes him feel that he is an additional burden to his friends and relatives. Those responsible for the care of such patients must be aware of these factors, and it may take gentleness, careful explanation and great skill to give the patient confidence.

Treatment and rehabilitation for the elderly patient with skeletal injury should start as early as possible. Too often, fractures are left unsplinted until roentgenograms are obtained, and such delay in treatment only tends to cause more pain and distress. Next in importance is reassurance—for the elderly patient is likely to be fearful, distrustful and lonely. Deafness and/or blindness, when present, adds to the fright.

Some elderly patients become bewildered, frightened and hostile if treated by their physicians in an abrupt or intolerant manner. The physician's sympathetic and cautious response to the patient's questions and needs makes a large difference in allaying his fears and gaining cooperation. The physician can gain much through careful questioning to find out the degree of independence prior to injury and the wishes of the patient and family in planning for treatment. It is often wiser to select a treatment plan of a conservative nature than to embark on an extensive radical approach that might be more suitable for a young healthy individual. Nowhere else in the medical management of the older person is it more important to tailor treatment to suit the wishes and requirements of the patient. At all times the physician must remember that the purpose of his treatment is to make the patient comfortable and to restore him to his preinjury state as simply and as expeditiously as possible.

The importance of good nursing care cannot be overemphasized. These patients are unhappy and distraught by being handicapped and in new surroundings, and while they may not have been disabled prior to hospitalization, they have become now completely dependent on someone who is nearby. The prompt availability of a bedpan may make the difference between a patient embarrassed by incontinence and one who is contented. While the hospital experience is rarely pleasant, the nursing personnel must attempt to make it dignified and comfortable.

Sensory deficit is very common in older patients. Their ability to move about and care for themselves is also diminished and, to prevent pressure sores, it is mandatory that these patients be re-positioned in bed every 2 hours. If the patient is able to sit in a chair, he must be instructed to shift his position to avoid skin breakdown. It is possible sometimes to get away without serious skin complications with poor nursing care,

but the fact remains that pressure sores which develop because of poor nursing care are usually preventable. When they occur, the patient's morbidity and hospitalization are greatly prolonged.

Rehabilitation of patients with skeletal injury is a very important part of total medical care. There are few disorders which require rehabilitation medicine more than injuries to the skeletal system, and it is incumbent upon the responsible physician to be knowledgeable in this field and to be able to carry on with it, intelligently and confidently. The purpose of rehabilitation is to minimize the residuals of what might become a serious disability, and to employ measures which will reduce or eliminate some of the complications which occur following injury. This includes proper nursing care, the judicious use of physical and occupational therapy, and the services of orthotists, social workers, psychologists and other health-related workers when indicated.

The proper planning for treatment of the skeletal system means proper evaluation of the injured patient. In every instance, from the most insignificant injury to the most severe, the physician must determine his goal and formulate a plan of treatment. He must then proceed to make use of all his medical and health–related colleagues. Sometimes in the course of treatment, he may find it necessary to consult other physicians to care for some of the complex problems which arise.

The presence of accompanying disease and complications which arise in the course of treatment in elderly patients with skeletal injury is extremely important. In a 3½-year period, Furey (1967) found that in 267 consecutive hip fracture patients admitted to a chronic disease hospital for convalescence following surgery, the following diseases were of importance in their management:

Disease	*Incidence*
Arteriosclerotic heart disease	124
Cerebral arteriosclerosis	88
Cataracts	45
Diabetes mellitus	22
Chronic alcoholism	18
Arthritis of knees	17
Pulmonary emphysema	17
Hemiplegia (side of hip fracture)	15
Hypertensive cardiovascular disease	15
Generalized arteriosclerosis	13
Parkinsonism	13
Malignancy	12
Obesity	11
Congestive heart failure	10
Miscellaneous	100

Many patients had more than one disease, and obviously any one can be a major threat—not only to the patient's life but also as a deterrent to the rehabilitation process.

Complications occur more frequently in older people because of debility and also because of deficiencies in care. Pressure sores, joint contractures, urinary tract infection, pneumonia, peripheral nerve palsy, thrombophlebitis and ankylosis of joints are some which appear with particular frequency. All are discussed in detail elsewhere and much can be done to diminish or eliminate their severity.

A word should be said about the use of anticoagulants. In recent years it has been suggested that they be used prophylactically during the course and follow-up of major surgical procedures. While there can be little doubt about the decrease in thromboembolic phenomena when anticoagulants are used, it must be remembered that complications brought on by their prophylactic use may be disastrous. It seems wiser to employ early mobility, exercises and use of elastic stockings, and to supplement these measures with a critical appraisal of the individual patient's problems prior to any initiation of anticoagulation. Hypertension, a history of duodenal ulcer and previous cerebral vascular lesions are possible contraindications to anticoagulants, and a prior occurrence of thrombophlebitis or phlebothrombosis is not in itself a definite indication for such therapy. The problem should never be solved in accordance with an established routine, but rather with judgment and appraisal of the individual case.

One of the most common sources of difficulty with skeletal injury in the aged is the problem arising from use of analgesics and sedatives. Pre- and postoperative delirium may sometimes be induced by narcotics and other medications when given in their usual dosages. The older patient generally requires less medication than the young. Semicomatose states and hypotension occasionally occur to such a degree from conventional dosages as to preclude surgical and other procedures. The use of sleeping medication is often not at all necessary and certainly should not be given as a routine. Admittedly it is common for hospitalized older patients to have enough difficulty in sleeping as to make them request medication repeatedly. Usually, however, when these requests are met, the result is more sleep during the day and less at night with the occasional problem of delirium and confusion.

All patients admitted to the hospital as emergency

cases must be carefully evaluated from a medical standpoint. If major surgical procedures are contemplated, an electrocardiogram, chest X-ray, blood counts and urinalysis should be the required minimum. It is always necessary for the physician to weigh the consequences of delay in surgical care against the risks and dangers of general anesthetic and major surgery in the face of complicating disease. This is not something that can be easily described but requires knowledge, experience and good judgment.

Discussion of most fractures likely to occur in older people will appear in the following pages. These are all well described and documented in many text books and medical journals, and the interested reader should refer to them for more detail and information regarding definitive treatment for specific fractures. Those that are included in the succeeding pages are fractures and dislocations which occur with frequency in the elderly patient and, because of the special nature of the aging person, are usually best treated by slightly different methods. Many injuries are omitted because of their rarity or because their treatment is well described elsewhere. It is true that though many of the principles of fracture care and techniques are the same for all age groups, injuries to the skeletal system in the elderly are best individualized.

SKELETAL INJURIES OF THE UPPER LIMB

Fractures of the Neck of the Humerus

The best method of analyzing fractures of the neck of the humerus in elderly patients is to decide whether the fracture is impacted or unimpacted, and to determine whether the humeral head is dislocated or in its proper position in relation to the glenoid fossa. It is also helpful to know the mechanism of injury, namely whether the radiographic appearance is that of an adduction fracture or abduction fracture. In the older patient, the commonest types of fractures of the humeral head and neck are: (1) the contusion crack fracture showing little displacement and angulation; (2) the adduction fracture; and (3) the abduction fracture. The incidence of these three groups of fractures is approximately the same.

While in young patients correction of bad position or malalignment is important, this usually is not necessary in the older patient. Most fractures are impacted, causing much less pain than in those fractures which are unimpacted. Treatment for these fractures is usually conservative and rarely, if ever, requires open reduction or even closed manipulation. Such fractures are usually treated with a sling or variations, using a sling and swathe or a Velpeau type dressing. The degree of pain will usually determine the degree and length of immobilization of the shoulder, but every effort should be made to start exercises to the glenohumeral joint as soon as possible. Obviously this varies from one patient to another, depending on individual tolerance to pain and the type of fracture involved. The contusion crack type fracture without displacement usually permits the patient to start exercises the day after the accident. Those patients with more severe pain and without impaction may find it necessary to wait a week or longer until some of the acute pain has subsided.

It is wise for the doctor to carefully explain to the patient the nature of the fracture and the goals of treatment. The patient must understand that the exercises which the doctor describes are valuable and important in obtaining a mobile and useful shoulder. The physician should instruct the patient and his family in the exercises to be done, with assurance that the patient will perform them several times daily under supervision by the family. There is rarely any indication or justification for the patient to visit a physical therapist.

The patient should also be told that ecchymosis will probably occur over the chest and down the arm sometimes even to the fingers. Ecchymosis almost always occurs to varying degrees and, unless the patient is forewarned, is always a source of anxiety.

Early in the course of treatment pendulum exercises should be prescribed. In order for these exercises to be done properly, the patient must bend forward as far as he can; sometimes it is helpful to rest the good arm on a table while bending forward. The injured arm should hang limply away from the torso with gravity and relatively pain free glenohumeral motion performed by complete relaxation of the injured arm and gentle motions of the body. This exercise is first done with the arm in a sling, but as soon as it has been mastered, the sling may be removed and the exercise done with the elbow in extension. During this early period, the patient should also be instructed in opening and closing his fingers, using his hand for light activities, and subsequently allowing his elbow to fully extend while doing the pendulum exercises.

By the end of one week, the patient is usually pain-free as long as his arm is hanging by his side. It is wise at this point to see that he is able to flex his elbow to his mouth and to start him in getting his hand to the top and back of his head, and also to get his hand to his buttock and shoulder blade. These motions usually take approximately 4 to 6 weeks to accomplish, but it is well to advise the patient of what is expected of him.

Individuals with such fractures should be seen about once a week for about a 6-week period, and it is best to give them 1 new exercise each time. At about 2 weeks post-injury, the patient should be able to do "rope and pulley" exercises with a rope over a door or thru a hook. The idea here is to have him use his good arm to elevate the injured one and to eventually achieve elevation of the arm with muscles on the injured side. The success of this, of course, is based on progressive improvement with disappearance of pain. After about 3 weeks, the patient should be instructed in standing sideways to a wall and to make his fingers crawl up the side of the wall so as to gain abduction at his glenohumeral joint.

These various exercises can be carried out quite satisfactorily, and although recovery is often slow and prolonged, the end result is usually a very good if not a completely normal shoulder. It is important for the physician to explain to the patient the fact that recovery is often prolonged over a period of 6 months to a year, that exercises should be continued, and that slow progressive improvement takes place during this period of time.

Fracture Dislocations of the Humeral Head and Neck

When dislocation of the glenohumeral joint occurs in association with fractures about the head and neck, attempts should be made to relocate the humeral head into the glenoid. When the patient is a poor surgical risk this may not be possible and the end result can be expected to be far inferior.

Gentle manipulation should be carried out under general anesthesia, with full awareness that injuries to the major vessels and nerves may be catastrophic. Despite all effort, open reduction is usually necessary, and by this it is often possible to replace the humeral head in the glenoid fossa and to treat the patient postoperatively with a Velpeau or sling followed by exercises. At open reduction for these fracture dislocations, it is also often necessary to piece portions of a comminuted fracture together if the fragments are large enough. This is nicely done with Kirschner wires. Various methods of internal fixation have been used with varying degrees of success. Where possible, reduction without metal fixation is advisable and the fracture can then be managed postoperatively as a typical unimpacted humeral neck fracture. The surgeon's judgment will dictate whether internal fixation will ease the postoperative management.

Occasionally it is wise to remove the entire humeral head and to resuture the musculocutaneous cuff of the remains of the upper humerus. When possible, however, the best results are obtained if the humeral head can be relocated in the glenoid fossa and on top of the upper humeral shaft. The poorest results occur in those patients who have had fracture dislocations without treatment, for they often have continued pain and weakness about their shoulder. It is true that in certain situations a major surgical procedure to restore the dislocation cannot be performed. All is not lost, however, because many of these patients with some limitation of activity can get along satisfactorily.

Anterior Dislocation of the Shoulder Joint

Simple dislocation of the glenohumeral joint, with or without a fracture of the greater tuberosity, is not an uncommon injury in the older patient. It usually occurs when the patient falls forward with the outstretched hand in front of him in order to catch his fall. The forces are resolved into a forward displacement of the humeral head from the glenoid and the dislocation occurs anteriorally. In order for this to occur, tearing of the capsule or the labrum from the glenoid has to take place, and the only way this will heal is if the dislocation is reduced and held in satisfactory position for approximately 2 to 3 weeks. An additional factor of importance is that when anterior dislocation occurs, there is often a small fracture of the anterior margin of the glenoid or a compression injury involving the posterolateral portion of the head of the humerus. These are often unrecognized by routine radiographs and represent important factors in causing instability of the glenohumeral joint following its reduction.

The diagnosis of glenohumeral dislocation of course is made by radiographs. In order to be absolutely certain of the type and degree of injury, one must get at least 2 views of the shoulder. Any views which are taken at about right angle planes to one another are satisfactory. The clinical findings substantiate the diagnosis. There is a typical loss in the normal round

contour of the shoulder, the acromion is prominent, all motions are limited and painful, and one can often palpate the humeral head lying beneath the coracoid anteriorly. In the clinical examination one should look for nerve and vascular injuries that sometimes do occur. The commonest nerve injury is to the axillary nerve with loss of sensation near the insertion of the deltoid muscle and also absence of contraction of the deltoid and teres minor muscles.

The methods of reduction traditionally have been those of Kocher and Hippocrates, both of which are well described in text books on fractures and dislocations. The Kocher method probably should not be used under any circumstances because of the danger of causing an additional fracture to the humeral head and shaft. The Hippocratic method employs traction through the arm with counter traction of the shoeless foot placed in the axilla against the lateral rib cage. Another method described by Stimson is probably the safest method and requires no anesthesia other than some sedation. In this method the patient lies prone with the involved arm hanging down over the side of the bed. About 5 to 10 pounds of weight is taped to the patient's hand and he is instructed to relax and to let the weight pull his arm downward as he relaxes. It is important for the physician or his assistant to sit with the patient while this procedure is carried out in order to assist when needed and to see that relaxation is maintained. It is sometimes helpful for the physician to guide the upper end of the humerus at the time when the dislocation spontaneously reduces.

Postoperative management includes the proper radiographic control to substantiate reduction, and immobilization in a Velpeau type dressing for approximately 3 weeks. Following removal of the dressing, the patient is instructed in the same type of exercises that are used with fractures of the neck of the humerus. Recovery, however, is considerably more rapid than with neck fractures. When a fracture of the greater tuberosity occurs in association with the dislocation, the fragment usually falls into normal position following reduction. Occasionally this does not occur and may require open reduction and fixation, or excision, but this is extremely rare. Other dislocations of the shoulder can occur but are extremely rare and do not warrant discussion here.

Fractures of the Shaft of the Humerus

Various types of fractures of the shaft of the humerus are occasionally seen in older patients. These may be spiral due to rotation stress, or transverse from angulation, or comminuted as a result of direct trauma. Proper management of these fractures in the elderly usually leads to prompt healing. It is only when injudicious treatments are employed that complications such as nonunion arise.

These fractures almost always heal if treated by closed means, and use of open reduction with various methods of fixation is rarely indicated. The hanging cast which has been popular for many years can be used, but the top of the cast often corresponds with the fracture site and may produce a nonunion. The hanging cast has an added disadvantage because in order for its effect to take place, the patient must sit or stand during the healing phase.

In treating this fracture, the physician must be sure that it is well aligned without overriding of fragments. Sometimes the fractures require closed reduction, but most of the time they are in satisfactory position when the patient presents himself to the doctor. One of the simplest methods of treatment is with the use of a Velpeau type dressing, having the arm hang by the side of the patient with the forearm at right angles to the upper arm. Various types of Velpeau dressings are used, but the author prefers using abdominal pads with a thin layer of zinc oxide ointment between skin areas, held in place with wide roller gauze holding the arm at the side of the chest, the elbow flexed to 90 degrees, and the forearm across the front of the lower chest or upper abdomen with the wrist and hand free. The roller gauze is held in place with another layer of adhesive tape. Radiographs are easily obtained and two views should usually be obtained so as to evaluate the position of the fracture fragments. The dressing is changed once a week for proper skin care and to permit the physician to clinically evaluate the position and state of healing in the arm. In the elderly patient, by the end of 4 weeks, the humerus is usually clinically solid and can then be treated with simply a sling so that pendulum or circumduction exercises can be gradually started.

The most important complication of humeral shaft fractures is injury to the radial nerve. This leads to a wrist drop and inability to completely extend the thumb and the metacarpophalangeal joints. If this should occur, the best treatment is application of a small splint to the deformed hand to give support to the wrist, thumb, and metacarpophalangeal joints. It is rarely necessary to explore the radial nerve since spontaneous recovery usually occurs.

Supracondylar Fractures of the Humerus

In the elderly patient, fractures occasionally occur in the supracondylar region. These are not common but they do pose problems to the surgeon. The treatment is most frequently conservative. The older patient is not particularly suited for long bed rest so that skeletal traction usually is not indicated or justified. The most effective treatment is to see that reduction of any major deformity is corrected and to immobilize the upper extremity in a long arm cast, holding the elbow at about 90 degrees. The cast is usually removed in about 4 weeks and the patient allowed to start active motions at the elbow using a sling part of the time for support. Some limitation of motion may occur following this treatment, but the patients are much happier to have avoided a long hospitalization in traction, and the final range of elbow motion is almost, if not entirely, normal.

Open reduction and use of skeletal traction may be indicated in certain cases. The physician must use his own judgment in deciding the treatment based on the character of the fracture and the patient's needs and wishes.

Dislocation of the Elbow

Injury causing dislocation of the elbow should be mentioned because it is not uncommon in the older patient. It usually occurs in forward falls with the outstretched arm catching the brunt of the fall. The elbow is hyperextended and dislocates so that the radius and ulna are posterior to the humerus. Clinically there is a typical deformity with prominence of the olecranon posteriorly. In the author's experience, patients with dislocated elbows are often quite anxious and have a curiously oppressive attitude toward the elbow abnormality. The physician should carefully examine the arm to be sure that no neurological or vascular injuries have occurred.

Manipulative reduction is quite simple. The patient must be relaxed, either by general anesthetic or by a combination of local anesthetic and sedation. Traction is applied in the line of the deformity. The physician grasps the forearm while an assistant supports the upper arm and traction is applied with care not to hyperextend the elbow. As traction is continued, some flexion is gently introduced and there is usually a very satisfying "clunk" as the elbow is reduced. Radiographs must be taken to confirm the reduction and the elbow can be immobilized in a number of ways. The author's preference is the use of a bulky dressing and sling, several rolls of webril or sheet wadding around the forearm and arm, and the application of a loosely rolled elastic bandage. This is very comfortable and permits some limited degrees of motion so that active exercises can begin immediately. This dressing can be changed at weekly intervals allowing more and more motion as pain subsides. No immobilization should be used after 3 weeks.

The major complication of dislocation of the elbow is stiffness. The last few degrees of extension or flexion are often very long in returning. The additional appearance of myositis ossificans, especially in the region of the brachialis muscle, further adds to limitation of motion. In the postreduction management of dislocated elbows, it is very important to have the patient do his own active voluntary exercises and to avoid passive range of motion performed by others or by fancy gadgets.

Fractures of Olecranon Process

Undisplaced fractures of the olecranon process can be treated simply with a long arm cast for approximately a 6-week period and gradual mobilization. When displacement occurs, however, open reduction is usually advisable since unhealed olecranon fractures produce a considerable degree of disability. The size and intactness of the olecranon fragment will dictate whether or not the fracture can be reduced and fixed with a crossed wire loop, or whether it is better to remove the olecranon fragment and to resuture the triceps to the shaft of the ulna. The latter procedure is extremely valuable in fractures which involve one-half or less of the articulating surface of the olecranon since immobilization need not be continued for longer than about 3 weeks.

Radial Head and Neck Fractures

These fractures rarely need open reduction or excision of the radial head in the older individual. Treatment should consist of a bulky dressing of the elbow using webril or sheet wadding which can be gradually reduced at 1-week intervals. Immobilization is usually continued for about 2 to 3 weeks, and thereafter the patient usually makes a gradual recovery with very little disability or limitation of motion. Some stiffness or limitation may persist, but this does not pose a major handicap to the older patient.

Other Forearm Fractures

Forearm fractures which are undisplaced are satis-

factorily treated with a long arm cast for 10 to 12 weeks. However, those that are displaced are difficult management problems. In these situations, open reduction is usually necessary and a variety of techniques are available which can be found in standard textbooks on fracture dislocations.

Injuries of the Wrist

The commonest fracture in the elderly patient is the Colles Fracture. The typical dinner fork deformity which has been described is well known. The fracture occurs when the patient falls forward on his outstretched hand and the weakest portion of the upper limb happens to be at the distal end of the radius and ulna. In the older patient, there is often considerable comminution and shortening.

There are many different ways of treating these fractures in the elderly patient. In the author's experience the method described by Strong (1955) is superior. With the patient supine, a special traction apparatus is used and either general anesthesia or local infiltration at the fracture site can be used for the relief of pain and for relaxation. While traction is applied, the deformities are corrected with gentle manipulation. A dorsal wraparound splint extending from just below the elbow to the metacarpalphalangeal joints of all digits can be applied for immobilization, holding the wrist in ulnar deviation with slight or no volar flexion. This is a very useful means of immobilizing this fracture in the elderly patient. Roller gauze is applied over the splint and may be cut to allow for swelling, with an elastic bandage wrapped over the gauze. This is extremely valuable in the older patient who has difficulty caring for himself, since the splint barely handicaps the patient and permits him to carry on his usual activities with a minimum of interference. The immobilization should be continued for approximately 6 weeks, at which time the splint is removed and the patient instructed on supination and pronation exercises, strengthening the wrist and fingers by grasping a rubber ball, and actual use of the fingers for activities of daily living.

During the period when the patient is immobilized in plaster, one of the biggest problems is stiffness of joints. The physician must always be mindful that such a problem represents the most common complication of this fracture. The shoulder joint is particularly prone to become stiff since the patient is not using his arm in a normal fashion. Simply placing the forearm on the top of his head at intervals is extremely valuable because it decreases swelling of the fingers and also permits good motion of the shoulder joint. The patient should be instructed in a full range of motion in the shoulder, and it should be carried out and continued during the recovery phase. The fingers are also particularly prone to stiffness. Elevation of the arm to diminish swelling, proper cast care so that the wrist and hand are not too tightly compressed by the plaster, active motion in the fingers, and encouragement to use the hand for light tasks are all important measures leading to a useful mobile hand.

Skeletal Injury to the Hand and Fingers

The elderly person rarely sustains skeletal injuries to the hand and fingers. This is probably because he is no longer employed in dangerous activities where his hands may be crushed or injured. Instead, his major problems in older life are support and balance. When he falls he usually uses his upper limb for protection, sustaining injuries that usually occur anywhere from the wrist to the shoulder joint. Metacarpal and phalangeal fractures do occur occasionally, but their treatment is similar to those which occur at any age group.

SKELETAL INJURIES OF THE TRUNK

Injuries of the Chest

Older people are just as susceptible to injuries to the ribs as are young individuals, and because of osteoporosis, they are more prone to sustain a fracture. Fractures occur from direct blows such as by falling against a solid object, and have been known to occur from simple straining and sometimes when the patient is lifted or carried by other people.

For the most part, fractures of the ribs are of minor significance. Usually the application of a wide elastic bandage around the chest is the best treatment, giving the maximum improvement to discomfort. Pain is the most common complaint, and the patient may need to have a mild analgesic along with an elastic bandage to give relief.

The most important problem related to rib fractures, however, is that related structures may be injured or become diseased. Pneumothorax, hemothorax due to rupture of intrathoracic vessels, intraabdominal injuries, and pneumonia sometimes are associated with rib fractures—and it is these which are of major significance.

Occasionally costochondral separations occur. These

present the same symptoms and complications as rib fractures.

Injuries of the Pelvis

Injuries of the pelvis in the elderly patient are quite different from those occurring in younger patients, and usually occur as a result of a fall directly on the buttocks or hips. The commonest locations for these fractures are in the segments of the pubic rings, although they often involve the ischium and the entire iliac crest. Displacement and complications are unusual.

Treatment of these injuries is conservative and consists of bed rest until the patients are improved enough symptomatically to be able to walk with the assistance of a walker.

Complications can occur, however, and one should be aware of these. Paralytic ileus and hematuria are the most common. Urinary tract problems occasionally occur but are usually of minor significance.

Fractures of the Spine

The commonest cause of back pain in the elderly patient should be considered a fracture until proven otherwise. Compression fractures of the vertebral bodies are very common problems brought about because of the frequent occurrence of osteoporosis. This is particularly true with women who, as they grow older, almost routinely show some loss in the normal density of bone of the spine. Fractures in these people may be incurred by minimal trauma consisting of no more than a sudden jolt. The important symptoms are localized back pain and tenderness plus symptoms of paralytic ileus which often accompany the fracture. The degree of pain varies widely in older patients and is not a measure of the severity of the injury. There is usually a delay before the patient sees the doctor and during this time the patient will often develop symptoms of paralytic ileus manifested by bloating, constipation, nausea, and vomiting.

The cause of osteoporosis is unknown. There is, however, abundant evidence to show that bone formation in the aged is normal or increased but that the rate of bone resorption is markedly increased, leading to an eventual loss in the amount of mineral per unit of volume.

The current popular theories as to the etiology of osteoporosis are: (1)calcium deficiency either from poor intake, poor absorption or increased excretion; (2) decreased gonadal hormone secretion; (3) an increased proportion of dead bone, due to aging changes; (4) some combination of all these factors along with generalized malnutrition. Whatever the cause, osteoporosis is very common in the aged, especially so in the female, and most fractures occur in association with this disease.

Physical findings in the acute spinal fracture show point tenderness to be almost universal. The presence of abdominal distension and various degrees of ileus are common. If multiple vertebral fractures have occurred, the patient's height will be reduced and he will demonstrate a typical shortening of the trunk in relation to his total height along with varying degrees of deformities of his back.

Roentgenograms of the spine show the vertebral bodies to be less dense than normal. This is not always an accurate measure of the degree of osteoporosis, because at least one-third of normal bone substance must be removed before roentgenographic evidence of osteoporosis can be seen. The vertical trabeculae are the last to disappear and are often very prominent in well advanced cases. Widening of the disc space is common along with scalloping of the end plates of the vertebral bodies. Compression of the end plates anteriorly is very common in the thoracic spine, and as one nears the lumbar area, compression of the entire end plate is characteristic.

In the evaluation of a patient with a compression vertebral fracture associated with osteoporosis, the physician must correlate his physical findings with those of the roentgenograms. The history and the clinical findings, and not the X-ray, will suggest the duration of a new fracture and its location, especially when multiple compressions are present.

All patients must be carefully examined for neurological function. It is unusual to have a neurological deficit in the older patient with compression fractures of the vertebral bodies, but it can occur and must be recognized as early as possible. Presence of neurological findings makes the treatment entirely different from the usual case where the neurological examination is normal.

When neurological examination is normal, the treatment for these injuries is usually bed rest and the use of mild analgesics. The symptoms of ileus are rarely severe and will usually subside with very little treatment. The important aspects of the treatment include bed rest for the relief of acute symptoms followed by gradual resumption of activities as pain will permit, so that osteoporosis will not worsen from di-

suse atrophy. Bed rest is usually required for approximately 5 to 10 days depending on the severity of the symptoms. The use of corsets is very helpful in relieving pain, and since most compression fractures occur in the lower thoracic spine and lumbar regions, corsets play an important part in treatment. When compression occurs in the upper thoracic region, however, corsets and braces are often difficult to apply and serve as a major encumbrance to the patient. While the physician may feel that he is doing something, the patient will usually discard a corset or brace as soon as he possibly can on returning home.

The use of exercises is somewhat controversial. Exercises to increase back extension are recommended by many, but are often extremely difficult for older people to perform. The author's experience has been to advise patients not to flex or bend forward, but to stand as straight as possible in front of a mirror several times daily and take deep breaths.

Dietary advice is also thought to be beneficial, particularly with respect to the proper intake of protein, calcium (skimmed milk) and fruit juices containing Vitamin C.

Gonadal hormones are prescribed and it is the author's practice to use injectable hormones at about 6-week intervals for approximately 6 months. At that point, the patient can decide whether he will continue with hormone injections or change to one of the oral forms of medication. The injectable form is usually much less expensive, easily given, and the physician always knows that the patient is getting the medication.

The followup care of these patients should include reexamination for neurological findings as well as the degree of tenderness of the back and range of motion. Probably the most important followup examination is checking the height of the patient. It is rarely necessary to repeat X-rays, unless new episodes of pain occur. Measurement of height is a very simple and effective way to determine the patient's progress. Compression fractures of the osteoporotic vertebral spine are usually self-limiting, and while the patient may have several episodes during his lifetime, the process usually stops at one point in life and never returns. This is an interesting finding and is quite different from many other pathologic conditions or when glucocorticoids are used. In these situations there may be progression to the point of neurological involvement.

It is very important to realize that a diagnosis of osteoporosis is a clinical and roentgenological diagnosis of exclusion after many laboratory tests have been obtained. Many diseases mimic osteoporosis such as osteomalacia, hyperparathyroidism, multiple myeloma, malignant disease (either primary or metastatic), as well as others. In addition to the clinical examination and X-rays, elderly patients with compression fractures and loss in normal bone density should have: blood counts; urinalysis; blood analysis for calcium, phosphorus, alkaline phosphatase, acid phosphatase in males, total proteins and AG ratio; and a workup for multiple myeloma in all males and in all patients with anemia. It is only by exclusion that the diagnosis of postmenopausal or senile osteoporosis is made.

SKELETAL INJURIES OF THE LOWER LIMB

Fractures of the Hip

Fractures about the hip are divided into those which involve the femoral neck and those which involve the intertrochanteric and subtrochanteric regions. One of the greatest advances in the treatment of hip fractures was the development of internal fixation, especially for fractures of the femoral neck. Before the development of this technique, many elderly patients did not survive, and many who did were left badly disabled for the rest of their lives simply because this fracture rarely healed properly. On the other hand, intertrochanteric fractures will heal very frequently with or without internal fixation, though operation has added greatly to their overall management.

Fractures of the Femoral Neck

There is little question, today, that the best treatment for femoral neck fractures is surgical intervention. This is usually in the form of reduction and internal fixation or the use of a metal endoprosthesis. A variety of nails and pins are available for fixation of femoral neck fractures, and the rate of nonunion which was so high in the past now approximates 25–30 percent. When healing does occur, the onset of avascular necrosis of the femoral head is still a problem in approximately 25–30 percent of cases. If neither of these complications occurs, the patient usually has a normal hip with a normal range of motion without symptoms. The use of internal fixation devices also has permitted patients to get up soon after surgery and to walk with the use of a walker without weight bearing on the involved extremity. While this technique represents a tremendous improvement over past methods,

the existing incidence of nonunion and of avascular necrosis makes the treatment far less than perfect.

The use of the endoprosthesis to replace the fractured femoral head has been used rather extensively in recent years and has gained a definite place in the treatment of many femoral neck fractures. While the result following insertion of a hip prosthesis is rarely perfect, nevertheless it can be very satisfactory. Its advantages are that the patient becomes mobile and weight bearing much sooner and does not have the complications of nonunion and avascular necrosis which may mean additional extensive surgery.

The choice of whether to reduce the femoral neck fracture and to use internal fixation or to use the prosthesis is a difficult decision to make. It is often wise to discuss the use of both types of appliances with the patient and family when possible. In general it is usually good treatment to use fixative devices in younger patients and those who would be expected to tolerate prolonged non-weight bearing and the possibility of reconstructive surgery later, if nonunion or avascular necrosis develops. The immediate use of a prosthesis is usually recommended for: (1) very elderly patients; (2) those individuals who would find it difficult to get around non-weight bearing for prolonged periods of time and (3) those who would tolerate poorly major surgery at a later date.

The decision and timing for major surgery on patients with fractures of the femur is often a difficult one. This takes training, experience, and good judgment on the part of the surgeon. In all instances, the risks of the major operative procedure must be weighed against the condition of the patient. In general, early surgical intervention is usually recommended and is usually in the patient's best interest. If the patient is in excellent health at the time of his admission and the electrocardiogram, blood count, urinalysis, chest X-ray, and physical examination are normal, the optimum time for surgery is probably shortly after admission. On the other hand, many patients are not in good condition and a period of observation of 1 to 3 days may be required before safely performing surgery. The presence of life-threatening acute processes, such as cerebral hemorrhage or myocardial infarction are probably contraindications to major surgical care. Otherwise the patient is probably best treated within the first 2 or 3 days of his accident.

A certain proportion of femoral neck fractures are classed as impacted abduction fractures. These are usually secure and can be treated conservatively without surgery or with the use of metal fixation. The majority of these fractures heal without the complications of nonunion or avascular necrosis, and either the conservative or surgical approach is accepted treatment. It must be remembered, however, that if fixation is not used for these fractures, a certain proportion will displace, become painful and later will require open reduction and fixation or the use of a metal prosthesis. Obviously, open reduction carries some risk and should be done only on those patients who are able to withstand surgery.

Though the use of the hip prosthesis represents a very important advance in the care of the femoral neck fracture, it is now evident that a new type of fracture occurs in association with the prosthesis. A number of fractures of the femoral shaft have been seen which usually occur somewhere in the region of the prosthetic stem. In these cases, the author's experience has been to perform an open reduction using a Thornton plate with the top hole cut off for fixation. In the region of the prosthesis, the screws must be carefully placed to straddle the stem. A hip spica is used for 6 weeks at which time healing is usually sufficient to allow the patient mobility without weight bearing. The use of skeletal traction and hip spica is another acceptable method which usually requires a longer period of bed rest.

Intertrochanteric and Subtrochanteric Fractures

While most of these fractures heal with conservative measures, the treatment of choice is the use of a nail/plate combination. There are many types available and most intertrochanteric and subtrochanteric fractures can be reduced anatomically and securely fixed with one of them. Occasionally comminution is so great that the fixation is not secure and the surgeon must then decide whether the patient is best treated with leg traction or immobilization in a hip spica. All of these latter methods are undesirable because they prolong immobilization and hospitalization. Occasionally, however, they are very useful in the management of a patient with an unstable, painful hip following open reduction and fixation.

General Considerations

The techniques and surgical approaches to the problems of hip fractures will not be discussed here. They are put forth in great detail in a number of publications and the interested reader is referred to them. What has already been discussed regarding hip frac-

tures, represents only a small part of the care for these elderly patients. No matter what treatment is used, convalescence is prolonged and optimum care is essential for satisfactory outcome.

The proper use of physical and occupational therapy is almost mandatory in the modern care of hip-fracture patients. Patients must be instructed in learning to dress themselves and take care of their activities of daily living as best they can. They must learn to transfer from the bed to the chair and to walk about as well as possible with the use of a walker.

The help of the social worker is extremely valuable. It is often necessary that arrangements be made for the patient to stay in a convalescent or nursing area or to make arrangements for the services of an attendant upon return to home. Certainly, the agile patient with a well treated fracture, with good family relationships and adequate space at home will do well with early discharge from the hospital. Unfortunately, many elderly patients live by themselves in cluttered apartments above the ground level and are unable to return home for many months.

In all situations associated with hip fractures, detailed arrangements have to be made which require the services not only of the physician but those of the social worker, the nurse, the physical therapist, the occupational therapist and sometimes community health organizations. It is no longer possible to treat only the hip fracture and to expect social and economic problems to be solved automatically.

In the medical management of the hip-fractured patient, it is very important to anticipate the complications which may arise. Most complications are avoidable with good medical and nursing care. These include: urinary tract infections; abnormal hip positions; pressure sores; knee contractures; wound infections; peroneal nerve palsy; thrombophlebitis; pneumonia; and many others related to the multiple diseases which many older patients develop. Care of the hip fracture is still very difficult, and though the death rate has sharply declined during the past 50 years, we still have problems with fracture healing along with complications.

Urinary tract infections can be controlled by use of medications such as Gantrisin or Mandelamine. Special catheter teams are valuable to relieve the physicians who may be unable to introduce a catheter when needed. Specialization by a catheter team generally provides better and more sterile techniques.

Abnormal hip positions are usually brought about because patients are left in bed and not given proper care. Simply getting the patient in a chair with the knees flexed and starting him on an active physical therapy program will correct this.

Pressure sores are avoidable and there is nothing mysterious about their occurrence. Too much pressure in a certain area for too long is the primary cause and can be prevented by good nursing care with shifting the patient's position in bed every 2 hours. Peroneal nerve palsy occurs most often as a result of pressure on the nerve trunk at the level of the fibular neck. It may occur bilaterally and usually develops when the patient is at bed rest with the lower extremities externally rotated.

Most of the time, good nursing care and proper planning with physical therapy, occupational therapy and the other allied health services will eliminate many complications.

Fractures of the Shaft of the Femur

Fractures occurring in the shaft of the femur are not uncommon in elderly patients. While the use of intramedulary nails and other metallic devices are very useful for the middle-aged or young adult, osteoporosis and other complicating diseases make some form of skeletal traction the best treatment for femoral shaft fractures in older people. The use of a Steinmann pin inserted in the region of the tibial tubercle and the application of traction with the leg suspended on a Thomas splint and Pearson attachment is probably the treatment of choice in the elderly individual. As soon as there is clinical union, the patient is either continued in the suspension or placed in a hip spica until solid union has occurred. When reduction has occurred, a long-leg plaster cast may be applied and suspended. This is a much easier and simpler method for handling the patient for long periods of time than with the use of the Thomas splint and Pearson attachment which frequently becomes disarrayed and uncomfortable for the patient.

Supracondylar fractures of the femur can be treated in the same manner and it is rarely necessary to carry out open reduction and internal fixation. Other treatment is recommended only when femoral condyle fractures with displacement occur which can only be reduced by open methods.

Fractures of the Tibial Condyles

Most fractures of the tibial condyles in elderly people are crush-type injuries without the presence of any

prominent fragment. The use of open reduction or other open methods are rarely indicated. This fracture is best treated either with a long-leg plaster cast or by the Apley method with skeletal traction using a tibial Steinmann pin. If the plaster cast is used, the patient is usually immobilized for about 6 weeks and then started on early motion, and after 3 months, weight bearing can be permitted. When skeletal traction and early range of motion are used, the patient must remain in bed for 4 to 6 weeks, but full weight bearing is not usually permitted until 3 months after the onset of the injury. Results by either method are very good, even though some deformity may exist at the knee joint. Convalescence is prolonged for many of these knee injuries, and the patients usually require a walker for many months after the injury. Final results, however, are usually very satisfactory in that patients have good range of motion and can walk without support.

Tibial Shaft Fractures

Tibial shaft fractures occur not uncommonly in elderly patients. For the most part these fractures are best treated with long-leg plaster casts after reduction. The use of internal fixation is rarely necessary. The reader is referred to standard publications for further descriptions of this fracture.

Fractures About the Ankle

The same type of injuries occurs in the elderly patient that occurs in younger individuals. The various types of fractures and dislocations about the ankle are well described in standard text books on fractures and dislocations and will not be detailed here. It is important to realize that while open reduction is often advised in the younger individuals, most of the time the older patient can be satisfactorily treated with closed methods and plaster immobilization. While long-leg plaster casts are used for the younger individual, it is often acceptable to apply short-leg plaster casts in the elderly and still maintain satisfactory reduction of the fracture dislocations. This is of great significance to the older patient who has enough difficulty getting around on two feet without having to resort to one leg and a walker.

Fractures of the Foot

The commonest fractures about the foot are those involving the os calcis, the metatarsals and the phalanges. Fractures of the os calcis are usually crushing in type with loss of Bohler's angle and occasional involvement of the talo calcaneal joint. Most of these fractures are best treated conservatively. It is extremely important to put these patients at bed rest for several days. The author's practice has been to wrap the foot with several rolls of webril held in place with an elastic bandage and elevate the foot. Swelling and ecchymosis are usually extensive and the circulation of the foot is the primary consideration. The patient can usually get up and around with a walker after approximately 10 days to 2 weeks and is instructed in range of motion of his foot and his heel. He can touch his forefoot to the floor to take some weight, but because of pain is usually unable to take weight through his heel for approximately 3 months. During this time, however, he may be ambulatory and able to do exercises of his foot, and the end result is usually quite satisfactory. Occasionally a plaster cast with a walker in it, with the foot in some equinus, is helpful for walking and weight bearing.

Reduction of os calcis fractures in the elderly is rarely necessary. If it is done, it is important to wait about 10 days until swelling has diminished. Circulation of the foot is the primary consideration. A good functional foot with some displacement of the os calcis is much better than a well-reduced fracture in a foot deprived of circulation.

Fractures of the metatarsals are very common. These represent the avulsion type at the base of the fifth metatarsal and through the shafts or necks of the metatarsals. These fractures are rarely displaced and the treatment of choice is to apply a short-leg cast with a walker and to allow the patient to bear weight. This provides great comfort for the patients and enables them to carry on their daily activities. Immobilization is usually required for approximately 4 weeks.

Fractures of the toes rarely represent a problem unless circulation is a major factor. The most important aspect of treatment is the amount of swelling, and consequently the circulation to the toes. Elevation is often necessary for a couple of days to minimize the swelling. As long as no displacement is present, treatment is primarily symptomatic. The patient is usually unable to wear his shoes and will have to get around with either slippers or shoes that are cut out. The use of tape to fix the injured toe to the neighboring toe is a popular treatment which has potential dangers in the older patient and must be used cautiously for fear that circulation will be embarrassed.

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SECTION A/DISEASES AND DISORDERS MOST RELEVANT TO SINGLE ORGAN SYSTEMS

Part IX/The Endocrine System

ENDOCRINE CHANGES WITH AGING SIGNIFICANT TO CLINICAL PRACTICE

By

Thomas H. McGavack, M.D.

INTRODUCTION

Aging is usually represented as a highly abnormal, although passive process in which the various tissues and functions of the body are simply "wearing out." In such a concept, senescence and death are fatalistically inescapable consequences of the degenerations of aging. In a biological sense, aging (and death) must be looked upon not as simple functions of time but as the accumulative effect upon the organism of a broad spectrum of circumstances and experiences which are genetically and environmentally controlled. No biological system has ever achieved immortality nor does "the scheme of things" indicate that such a state can be considered either possible or desirable. For the preservation and development of species, death of the individual and reproductive perpetuation are absolutely essential.

Strehler and Mildvan (1960) have shown a downward trend with aging in certain biological functions of man. These include not only changes in the endocrine glands but also alterations in other bodily functions.

While in the aged it is often difficult to separate health and disease, nevertheless, it appears that many, if not all, bodily functions decrease with age even in the absence of overt disease, or in the presence of disease which may be endocrine oriented. For example, there are certain fish in which death is routinely associated with, and probably due to, a severe overactivity of the pituitary and adrenal glands associated with a mixture of the clinical features of acromegaly and Cushing's syndrome (Robertson and Wexler, 1960). Thus, not all of the disturbances of aging in the endocrine glands are degenerative in nature. Some of them are quite active processes as in the illustration just given.

Moreover, not only quantitative but also qualitative variations in the ratios of hormonal substances occur with age. The evidence is sharp and clear cut that the several glands of internal secretion change their levels of activity with a time pattern which is distinctly individualistic. Whether any of these changes are the primary cause of aging or merely accompaniments of the process, or even results thereof, is certainly not proven. Nevertheless, the fact that these changes are probably active rather than passive in nature indicates the possibility that they can be altered by external stimuli or influences when sufficient information regarding their nature is at hand.

Examples of changes in the endocrine glands in early life include the rapidly decreasing thymic activity, beginning at birth and ending in puberty and early changes in the pineal body, including calcification. A high level of thymic activity is a feature of earlier years, while growth hormone titers in the pituitary are relatively stable from the time of full maturity onward.

When we speak of other glandular functions in the pituitary, the gonads, the thyroid and the adrenals, it would appear that the major changes in these structures associated with aging begin in middle or late middle life, and are apparently triggered by the alterations in gonadal function seen at this period. If one reflects upon the nature of the changes to be observed, it is difficult to place many of them among the degenerative alterations usually ascribed to, or associated with senescence. On the contrary, studies of gonadal, thyroidal and adrenocortical function, carried out

during the past 25 years in a relatively large number of individuals, lead us to believe that these changes are active ones and can be influenced by exogeneous factors, perhaps in such a manner as to improve the overall health of the older individual. It may be rewarding to view some of the endocrine changes occurring throughout life with these thoughts in mind.

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THE ANTERIOR PITUITARY GLAND

CHANGES IN PITUITARY SECRETION WITH AGING

At least 6 well-recognized and characterized hormones are present in and secreted by the anterior pituitary gland: growth (STH), thyroid-stimulating (TSH), adrenocorticotropic (ACTH), follicle-stimulating (FSH), luteinizing (LH) and luteotropic (LTH).

After adolescence the amount of STH present in the pituitary remains constant even throughout old age (Daughaday et al., 1959; Ganzell and Heijenskjold, 1956; Hershberg, 1957; Li, 1960; Rubin, 1960), although the level of circulating hormone may be decreased (Pearson et al., 1960; Welsh and Meymarian, 1964).

The total secretion of ACTH probably diminishes in old age (Hickler, 1962), a change which may be directly related to and commensurate with the loss of body muscular mass. The response to a given dose of ACTH decreases with age (Pincus, 1962; Hickler et al., 1959).

Thyroid-stimulating hormone remains at high levels until the age of 35. It then gradually decreases to a relatively low level in both thyroid gland (Bakke and Lawrence, 1959) and blood (Bottari, 1959) by the age of 70; thereafter, it remains more or less constant in amount.

In the female, the pituitary gonadotropins rise rapidly at, or shortly before puberty, and remain at rather constant, but fluctuating levels throughout the reproductive period of life. At and after the menopause, they show changing relationships. Follicle-stimulating hormone increases in amount and may remain high for some 15 to 20 years after which there is a slow and gradual decline. Luteinizing hormone declines slowly from middle or late middle life onward but is maintained in modest amounts into old age. It may continue to function in these later years as a stimulus to the adrenal cortex to produce gonadal steroids (Jones, 1949; Seyle, 1950), although this point needs further study. Luteotropin disappears at, or shortly after the menopause, except for minute traces which are believed, although not proven, to be present for the rest of life.

In premenopausal women, between the ages of 10 and 50, there is a "progressive and fourfold rise in the concentration of gonadotropins in the urine" and this value continues to rise for from 15 to 20 years after the cessation of menses (McGavack, 1955). A similar pattern has been observed for men, although the increase between 10 and 50 years of age was twofold and the subsequent additional increase was not so marked as that seen in women (Albert et al., 1956; McGavack, 1955).

INFLUENCE OF HORMONES OF OTHER GLANDS ON PITUITARY SECRETION

Growth hormone is opposed functionally by the use of gonadal steroids, particularly estrogens, although its secretion seems not to be depressed by them. Gonadal steroids "oppose" long-bone growth by their action in producing closure of epiphyses and not by direct action upon the pituitary or its growth hormone. It would appear that STH and TSH are synergistic in their actions. Either appears to be capable of promoting growth alone, but growth is not complete unless the two are combined.

Thyrotropic hormone is suppressed by thyroid hormone. It has a stimulatory action upon the thyroid in the production of thyroid hormone and also upon thymic tissue. There is probably more than one thyroid stimulating substance. However, the only one recognized as coming from the anterior pituitary is the so-called normal TSH. A "long-acting thyroid stimulating hormone" and an "exopthalmos producing substance" are recognized as closely allied to, but not identical with, the thyroid stimulating hormone isolated from the pituitary gland. The origin and identity of

these are somewhat in doubt but their possible existence in certain clinical states deserves mention.

Both estrogen and androgen suppress TSH as well as growth hormone, only if present in very large amounts. The slow decrease in TSH with age indicates a loss of stimulation to the thyroid gland with secondary diminution of thyroid hormone production. However, the thyroid gland remains responsive to as little as five international units of TSH into ripe old age (Baker et al., 1959; McGavack, 1959). It may be concluded that in a majority of individuals the change in TSH is primary and the change in the thyroid secondary.

Adrenocorticotropic and gonadotropic hormones, the feedback mechanism by which 11 oxycorticoids regulate ACTH production by the pituitary, is steadily present throughout life. Regulation of gonadotropic hormone secretion by the pituitary is intimately connected with ovarian and testicular functions and in the female waxes and wanes with the various phases of the menstrual cycle. Luteotropin is known to be produced only so long as corpus luteum formation continues in the female. Small amounts, without known physiological significance, are found in the male. Lutenizing hormone secretion may be subject to the circulating levels of androgen and estrogen secretion, no matter what their source.

IMPORTANT CLINICAL IMPLICATIONS AND APPLICATIONS

It is difficult to discuss clinical applications of pituitary hormones as only one of these, ACTH, is actually available for routine clincial use. TSH is available as a test material. Experimentally in the human being, growth hormone of human origin has been used with rather specific effectiveness, but no clinically available sources of such material exist. Human pituitary gonadotropins have been little or not at all used in human beings.

While ACTH produces some effects not mediated through the adrenal cortex, most of its practical applications can be simulated by, or substituted for, by 11-oxycorticoids. Parenthetically, ACTH administration will not prevent the adrenal cortical suppression caused by the long-continued use of large to relatively modest amounts of 11-oxycorticoids.

Hypopituitarism

Hypopituitarism or pituitary failure may occur at any age. It may involve a deficiency of a single hormone or of all (panhypopituitarism) or of any combination of any two or more hormones of the gland.

The clinical picture will vary directly in relation to the absolute and relative deficiencies present. While cases of hypopituitarism are not common, their true incidence is unknown. In the older individual who seems prematurely senile and is apathetic, pale, weak, mildly anemic with lowered temperature and fairly wrinkled, dry, sometimes rough skin, the diagnosis of hypopituitarism should be entertained.

Urinary and blood assay levels for pituitary hormones may directly measure the severity of the deficit(s). However, much information may be gained by finding lower values of tests that show the level of function of "target" organs, i.e., those structures which normally respond to the tropic hormones produced by the pituitary. Among the more simple tests, a lowered BMR, a decreased urinary excretion of neutral 17-ketosteroids, a flat glucose tolerance curve and an atrophic type of vaginal smear should create a high index of suspicion, if not conclusively make the diagnosis. Tests to demonstrate a hypersensitivity to insulin should not be used, as severe hypoglycemia and even death have been reported from as little as 10–15 units.

Treatment should involve physiological replacement of the hormones of the major target glands in amounts commensurate with the severity of deficiencies thought to be present after interpreting the results of all functional tests.

Acromegaly

Acromegaly is predominantly a disease of the third and fourth decades of life, but may be seen at any time after full maturity. It is essentially the result of overactivity of the eosinophile cells of the anterior pituitary after full long-bone growth has been achieved. Hypersecretion of STH and TSH may both occur. The acromegaly involving jaw, nose, fingers, toes or any acral part and the thickening of flat bones and hypertrophy of some soft tissues, together with results of over-activity in pituitary target organs, readily establish the diagnosis. If eosinophilic tumor of the anterior pituitary is causative, local symptoms and signs of headache, visual field defects and enlargement of the sella turcica, often with erosion, are highly confirmatory.

In the presence of tumor with increasing encroachment upon vision, complete hypophysectomy is the

logical procedure. In less urgent situations, roentgen radiation, although a very clumsy, ill-adapted procedure, may be tried. Irradiation with the alpha-particle beam from a high voltage cyclotron may be better. However, sharp delineation of the area treated can be gained by the much more precise electron beam, which has been used extensively in Europe, but little or not at all in the United States.

In patients where tumor is not in evidence, subsidence of the hyperfunctional state often attends the employment of large doses of testosterone or estrogen, which are gradually tapered as control of symptoms and signs is achieved. Experience has shown that estrogens have not proved quite as satisfactory as testosterone for suppressing pituitary growth hormone activity, but some workers prefer it. "Burned out" or quiescent acromegaly is the condition most frequently seen in older individuals. It should remain untreated, as it has already undergone spontaneous recovery and is unlikely to be reactivated.

AVAILABLE PREPARATIONS

Growth hormone from other than primate sources has been ineffective in man. Indeed, growth hormone may play a role in the production and/or aggravation of osteoarthritis (Salmon, et al., 1963), a disease long looked upon as a common accompaniment of aging.

Thyrotropin is available as an aqueous extract. Inasmuch as the diagnosis of hypothyroidism is more difficult in the aged than in younger individuals, this drug may be used as a test to determine whether or not thyroid insufficiency is primary or secondary. However, all the therapeutic purposes it may serve in the older individual can be more cheaply and as effectively accomplished by the use of thyroid hormone itself.

Corticotropin (ACTH).—Numerous preparations are available. They can be divided into short-acting and long-acting preparations, the former being aqueous solutions which can be given subcutaneously, intramuscularly or intravenously and the latter long-acting in the form of gels which should be given intramuscularly. Doses of the former vary from 40 to 50 units daily in the average patient and of the latter from 10 to 15 units daily. This hormone is useful wherever a glucocorticoid may be indicated except in conditions associated with an underfunctioning adrenal cortex. It should be used with the same precautions as a glucocorticoid. As a means of maintaining adrenocortical activity in aged persons it seemed to have no real place. It is antagonistic to growth hormone in some of its actions while synergistic in others.

No pituitary gonadotropin has a place in clinical medicine at any age. Preparations from animal sources routinely produce antihormones.

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THE THYROID GLAND

The thyroid has been one of the earliest and best studied of the endocrine glands, probably because its hormone was among the first recognized, the first isolated in pure form, and the first synthesized. Perhaps too it is the first of the endocrine glands to have been observed in relation to functional changes with age.

Thyroid hormone is known to exist inside the individual thyroid follicle as a combination of hormonally active iodinated thyronines and globulin, in the serum as a mixture comprised almost entirely of thyroxin (tetraiodothyronine) and a small amount of triiodothyronine, and in the tissue cells mainly as triiodothyronine.

The thyroid also produces a hormone of polypeptide nature, called thyrocalcitonin, which is capable, in relatively minute quantities, of lowering serum calcium and inorganic phosphate, an effect probably mediated through an influence on the deposition of bone salt (Hirsch et al., 1964). Nothing is known about variations in thyrocalcitonin as a function of age.

THYROID SECRETION WITH AGING AND THE INFLUENCE OF OTHER HORMONES

The thyroid gland reaches its maximum size and activity probably between the ages of 20 and 25 years. From this point forward until the eighth decade of life there is a gradual decline in basal oxygen consumption and in thyroidal activity in general, as measured not only by the lowered basal metabolic rate but also by a decrease in the uptake of radioactive iodine (I^{131}) and thyrotropin secretion and release. Serum protein-bound iodine values do not change with age but the total serum iodide does (Hoch et al., unpublished). In recent studies, a positive correlation existed between age and the urinary androsterone/etiocholaneolone (A/E or alpha/beta) ratio (McGavack and Hoch, 1965). It has long been known that the thyroid is capable of influencing the production of neutral urinary 17-ketosteroid precursors, particularly in altering the A/E ratio, as well as the total amount of 17-ketosteroid material found in the urine. As a result of the decrease in thyroid function with age, there will be a corresponding decrease in the total value for urinary 17-ketosteroids and for the A/E ratio (McGavack, 1951). In young people, the normal A/E ratio may range from 0.6 to 1.2 (Gallagher et al., 1960), but may decrease in the aged to as little as 0.2 (McGavack et al., 1955).

The production of 17-ketosteroid precursors, androgenic substances, decreases with age even if gonadal and adrenal functions are not primarily disturbed. In actuality, diminished thyroidal activity accentuates the disturbance produced in the A/E ratio and in the total amount of urinary 17-ketosteroids. The reverse may not be true; a loss of gonadal function will not necessarily influence thyroid activity. On the other hand, a loss of adrenal function may be shown to decrease thyroid activity. The degradation of thyroid hormone seems slightly decreased with age (Gaffney et al., 1959) reflecting a diminished rate of degradation of thyroxine (Galton and Ingbar, 1960). Simultaneously, there is a slowing of the rate of release of thyroidal iodide with senescence (Rosenberg, 1958; Wilansky et al., 1957).

While the changes just described are undoubtedly due to alterations in the thyroidal production of thyroid hormones, the question as to whether they are primary in the thyroid or secondary to a lowering of thyrotropin (TSH) secretion by the pituitary has not been fully settled. In some instances, we have found the thyroid of older people unresponsive to TSH, and in others, a single small dose (5 units) of TSH is capable of raising the radioactive iodine uptake from a very low figure to normal.

It is well known that the adrenal cortex influences the level of activity of thyroid function, but this rela-

tionship has not in any way been shown to be directly a function of age, nor is there any clear-cut evidence to indicate that the sensitivity of thyroid to adrenal cortex or 11-oxycorticosteroids changes with age.

In summary, it can be said that a gradual decrease in thyroid function tends to occur with age, as demonstrated by a decrease in basal metabolic rate, thyroidal uptake of radioactive iodine, a lowered level for circulating hormone, decreased degradation of thyroid hormone, a decreased thyroid secretion rate, atrophy of the thyroid gland, and perhaps a decrease in the total amount and alteration in the pattern of urinary neutral 17-ketosteroid excretion. That these changes may be secondary to a pituitary rather than a thyroid disturbance in aging is suggested by the fact that more than 70 percent of the individuals given TSH respond promptly by increasing their uptake of radioactive iodine to that of a younger individual.

IMPORTANT CLINICAL IMPLICATIONS, APPLICATIONS, AND TESTS

One might conclude from the above facts regarding the decrease in thyroid function during aging, that the administration of thyroid hormones might slow or at least alter the aging process or processes by the substitution of patterns seen in younger individuals. From what is known of the relationships between thyroid and gonadal functions (McGavack and Hoch, 1965) it would seem unwise to use the hormones of the thyroid alone. The evidence does indicate that when used in conjunction with gonadal steroids, at least some of the changes of aging may be retarded, but certainly not stopped.

HYPOTHYROIDISM AND HYPERTHYROIDISM IN THE ELDERLY

The diagnosis of hypothyroidism and hyperthyroidism in the elderly is complicated not only by the changes which normally occur in the thyroid gland with aging but also by those which occur in the body generally, such as variations in nutrition, environmental influences, life habits and so forth. The tendency for hypothyroidism to be confused with vitamin deficiency (particularly A, B and C), severe anemia and chronic nephritis is accentuated with age, as all of these disturbances are more common in the elderly than in younger individuals. Moreover, all of the common manifestations of the disease are manifestations which are often seen in older individuals, who have no signs of myxedema. Reference here should be made to such symptoms as weakness, coarseness and dryness of the skin, sensitivity to cold, slowness of thought and speech, impairment of memory and so forth. For these reasons, hypothyroidism is much more difficult to detect in the aged than in the younger individual.

Myxedema

In view of the extreme difficulty often experienced in distinguishing myxedema from many other conditions found in aging, a repetition of the symptoms and signs found in myxedema with their approximate incidence may be of value in leading the clinician to consider the diagnosis more frequently. These are:

In 80 percent or more—weakness, coarseness and dryness of the skin, sensitivity to cold, apathy, decrease in sweating, cold skin, slowness of speech, edema of eyelids or face, impaired memory, coarse hair, thick tongue.

Between 60 and 80 percent—increased weight, loss of hair, large heart, myxedematous pallor of skin and lips, hoarseness or aphonia, constipation, dyspnea, myalgias and arthralgias.

Between 30 and 50 percent—anorexia, nervousness and irritability, peripheral edema, palpitation, precordial pain, weakened heart sounds.

Occasionally—poor vision, disturbed hearing, choking sensations, atrophic tongue, dysphagia, increased salivation and many other manifestations of altered metabolic activity.

When fully developed, one can scarcely fail to recognize spontaneous adult myxedema: the usually, but not always, short, frequently overweight, pudgy-faced, somewhat expressionless individual who responds to questioning slowly but accurately in a hoarse voice and complains only of extreme weakness.

The predisposing constitution is that of a well-extroverted individual of short stature, broad shoulders, thick neck, chubby hands and stubby fingers. With development of the disease, the disposition becomes changeable.

In the fully-established disease, difficulty in concentration, loss of memory, indecisiveness, apathy and myxedema of all tissues are present.

In the difficult case, several less commonly used laboratory tests may be of help. Capillary permeability, which is not affected by aging per se, is increased in all patients with myxedema. Total blood serum protein may be normal or high but, in either event, the

albumin fraction is disproportionately increased. Circulation time is markedly slowed. Total urinary 17-ketosteroids are greatly decreased in myxedema—often to a lower level than that seen in severe Addison's disease. Common tests for thyroid function continue to be useful. The BMR is rarely above −20 and not uncommonly around −40. The complete blood count shows a secondary anemia. The protein-bound iodine (PBI) rarely exceeds 4 mcg/100 cc. Cholesterol is diagnostically confirmatory, if high. The large heart shown on X-ray is present in a considerable number of cases. The low or absent T-waves, the low voltages in all complexes, are characteristic of the electrocardiogram. Radioactive iodine uptake tests should not be undertaken lightly, as the thyroid is already highly underprivileged and may be damaged thereby.

Several laboratory tests not commonly necessary in diagnosing myxedema in the younger person may materially help us in the older individual:

(a) *Serum protein-bound iodine.* This is rarely if ever disturbed by aging per se but is usually low in myxedema.

(b) *Blood cholesterol.* Serum cholesterol is not elevated by aging per se but may be strikingly increased in myxedema. It is confirmatory only if elevated, as severe myxedema may be present with normal values (McGavack, 1951).

(c) *Blood serum protein.* The total value for blood serum protein is not disturbed by aging but may be elevated in myxedema, as a result of an increase in the albumin fraction. It is only confirmatory of this condition when elevated.

(d) *Urinary 11-oxycorticoids.* In hypothyroidism the value for 11-oxycorticoids is usually low, but the difference may not be of diagnostic value in the individual patient.

(e) *Capillary permeability.* Capillary permeability is increased in patients with myxedema (McGavack and Schwimmer, 1944; McGavack et al., 1945). Aging per se does not alter capillary permeability as measured by the fluorescein technique.

(f) *Triiodothyronine binding to blood cells.* The binding of triiodothyronine to blood cells is decreased in myxedema. This test can be quite confirmatory, but normal binding does not entirely rule out the possibility of myxedema.

(g) *Absence of responsitivity to TSH.*

Myxedema Coma

Myxedema, when long unrecognized and untreated, plays a predominant but indirect role in the immediate cause of death—usually pulmonary, cardiovascular or renal. However, a few cases deviate from this pattern in that complications play a much less important role and death with hypothermic coma terminates a long history of hypothyroidism.

In two good reviews (Angel and Sash, 1960; Nickerson et al., 1960) the records of 31 patients (exclusive of duplications) have been employed to create a composite clinical picture of myxedema with coma and hypothermia. Of these, 26 were women; 5 were 50 years of age or less, while 22 were 61 or more. The average age of all cases was 64.1 years, with a range from 19 to 82 years. This is a morbid condition seldom found except in older people. While rare, its importance rests upon the fact that it may be fatal, despite the use of full thyroid replacement therapy.

These patients all have the characteristic historical, physical and laboratory findings of myxedema. They may first be seen with coma already present or in a state of lethargy gradually lapsing into coma. In some 25 percent, cerebral function is disturbed in such a manner as to precipitate seizures of an epileptiform type. Hypothermia which may be severe (75.2°F is the lowest recorded) is the most striking feature of the clinical picture. Recovery has been noted with initial body temperatures as low as 87°F, but death may occur when the initially recorded temperature is 95°F or even higher. The pulse rate is slow; blood pressure is variable and shows no discernible pattern. Despite the low body temperature, shivering is never observed. The condition is commonly seen in the winter months; therefore cold is a *precipitating* factor.

Laboratory indices of thyroid function invariably confirm the presence of myxedema. Under the circumstances, serum protein-bound iodine (PBI) is the least traumatizing and most informative of these procedures. The blood urea nitrogen is usually elevated. A mild secondary anemia is present. The hyponatremia (despite high total body sodium), the hyperkalemia and the low urinary 17-ketosteroid values may be as disturbed as in Addison's disease, although low-serum potassium levels have been recorded. Serum cholesterol may be normal or high.

Therapy in the coma and hypothermia of myxedema is concerned with:

(a) general measures aimed at gradually improving all bodily functions; and

(b) specific medication designed to restore a normal level of thyroidal hormone activity.

General measures should be predicated upon the fact that the vital functions of the individual are totally incapable of resisting any stress. These people must be handled as cautiously as the patient with Addison's disease in crisis. The room should be darkened and a minimum of attentions should result in a maximum of diagnostic and therapeutic activities. The body should be rewarmed by external means—but *over-heating* must be avoided.

Theoretically, full replacement of thyroid hormone should result in cure. However, too rapid replacement may cause a complication such as myocardial infarction with ensuing death.

The choice of thyroid preparation and route of administration are most important. Absorption from the G.I. tract and even from the intramuscular spaces is slow and uncertain. Intravenous administration has the advantage of assured circulation. Both l-thyroxin sodium and l-triiodothyronine can be thus given. In-view of its more rapid action the latter is preferable for the *initial hours* of therapy. Full daily replacement with triiodothyronine will call for 70 to 120 mcg. daily, but initial doses should be 5 to 10 mcg. repeated every 2 to 3 hours; or a continuous drip may be used to permit administration of this amount every 2 to 4 hours, as may be deemed wise in the individual case. Complications should be continuously watched for, as their avoidance may be the difference between recovery and death. The hypothyroid patient is highly susceptible to infection, so that a broad spectrum antibiotic should be employed prophylactically. If blood sugar is low or there is evidence of depressed hepatic function, adrenocorticosteroid therapy may be used to good advantage. It can be administered intravenously with dosages varying according to need from 50 to 200 mg. daily until the comatose state is controlled.

A word should be said about the treatment of myxedema in elderly patients, since problems are often met which are not necessarily present in younger individuals. In the condition, it is clear that the longer any individual has had his disease and the more severe the disease, the less well is thyroid hormone tolerated. This statement applies with greater force to the older than the younger person with myxedema. The heart in the older person is often not capable of sustaining the stresses for which compensation can be usually achieved by the young and particular care must therefore be exerted in treatment.

It is well to begin with 0.25 grain of desiccated thyroid substance or its equivalent in triiodothyronine or thyroxine sodium as a starting dose. However, if the patient shows aggravation of an associated cardiac condition, that is, an aggravation of tachycardia or anginal-like pain, a still lower dose must be used. Moreover, increases in the dosage should be spaced at well-regulated intervals. If desiccated thyroid substance is used, it must be remembered that the full effect of its metabolic action will require from 4 to 6 days, Therefore, any given dose should be operative for at least 2 weeks before an increase is contemplated. For safety's sake, it is best to increase dosages at intervals of 3 weeks. In this way, it is often possible to avoid cardiac failure and coronary occlusion, complications that are far too often seen in relation to the therapy of the disease.

Hyperthyroidism

When one turns from under-function to over-function of the thyroid gland in aging, similar difficulties in diagnosis appear. As a general rule, hyperthyroidism in younger individuals can be diagnosed "on sight." However, in the older person many of the landmarks of typical thyrotoxicosis are missing or can easily be confused with other diseases which are common at this period of life. Nervousness, apprehension, palpitation, insomnia, anorexia, weakness, high systolic blood pressure, loss of weight, cardiac irregularities, stare, elevated basal metabolism—singly or in combination—may be present in older individuals who do not suffer from hyperthyroidism.

In the differential diagnosis of this condition in older individuals, we must consider the climacterium, psychoses, neurocirculatory changes associated with arteriosclerosis and hypertension, as well as essential hypertension alone. Details of the common symptoms of the disease may assist in a correct diagnosis:

(a) The nervousness of hyperthyroidism is continuous, that of the climacterium and many other confusing conditions is liable to be paroxysmal.

(b) The tremor of hyperthyroidism is very fine; other tremors commonly seen in aging individuals are coarse.

(c) The skin of the patient with hyperthyroidism is continuously warm, moist and thin; in the climacterium the skin is alternately hot and cold and alternately moist and dry.

(d) The hyperthyroid patient is continuously warm; this is not true of other confusing conditions.

(e) The tachycardia of hyperthyroidism does not disappear during sleep or after rest.

(f) If the older patient has an excellent appetite and is still losing weight, then not only hyperthyroidism but also diabetes mellitus and other nutritional diseases must be considered.

(g) Widening of the pulse pressure and hypermotility of the heart are common signs in hyperthyroidism, but in the elderly these manifestations can be produced by arteriosclerosis or by essential hypertension, more particularly the former.

(h) In borderline cases, a therapeutic test with an antithyroid compound is justifiable. If this controls the cardiac irregularity or the tachycardia, as well as other manifestations present in the older hyperthyroid patient, the diagnosis has been confirmed, for antithyroid compounds will have no perceptible influence upon hypertension or arteriosclerotic heart disease.

(i) In hyperthyroidism in the elderly, the basal metabolic rate is less informative than in the younger person. First, the test is more difficult to perform in the elderly and second, it is frequently increased in hypertension and in arteriosclerotic heart disease. It is also increased in leukemia and in certain types of renal failure. However, a greatly elevated rate in an individual with a nodular goiter and other local signs is highly indicative of increased thyroidal activity.

(j) Serum protein-bound iodine is not affected by age per se, nor by any of the diseases which are usually confused with hyperthyroidism in the aged. Therefore, an elevated serum protein-bound iodine is bona fide evidence of increased thyroid activity in the older individual.

(k) Creatinuria occurs in all individuals with thyrotoxicosis, irrespective of age. Therefore, a determination of the 24-hour urinary output of creatine is perhaps one of the most useful tests for differentiating hyperthyroidism from other diseases in older individuals. In this connection, it must be remembered that values above 30 mgms. in 24 hours in men should be considered confirmatory of hyperthyroidism provided certain muscular diseases and dietary contributions can be ruled out. For women the value should be no less than 150 mgms. in 24 hours before it should be considered helpful in making the diagnosis of hyperthyroidism.

(l) Circulation time is usually shortened in cases of hyperthyroidism, but in patients with concomitant cardiac failure, this shortening may be masked by the tendency for cardiac disease to lengthen circulation time.

(m) Radioactive iodine uptake by the thyroid remains a useful diagnostic tool in older patients with suspected hyperthyroidism.

Three definitive forms of treatment for hyperthroidism are now open to the practicing physician (these do not include attention to the emotional status of the individual):

(a) Antithyroid compound therapy to suppress the production of thyroid hormone.

(b) Radioactive iodine therapy to destroy the glandular tissue of the thyroid *in situ*.

(c) Surgical removal to reduce the amount of active thyroid tissue present.

Depending upon individual circumstances, any one of these methods of approach is applicable to the average case of hyperthyroidism in younger individuals. In the older person, however, one must give much more careful consideration to the choice of agent. The only one of these methods which will not aggravate an already existing cardiac failure is the antithyroid compound. Inasmuch as very rapidly acting antithyroid compounds, such as methimazole and carbimazole, are now available, little or no time is lost in improving the cardiac status without any known untoward effects, unless the patient proves to be hypersensitive to the drug—a rare event indeed.

Once cardiac competency is restored, the patient then may be electively continued on antithyroid compound treatment, switched to radioactive iodine administration or surgically referred.

In considering radioactive iodine treatment, *de novo*, one must remember that 100 percent of the patients who receive this treatment therapeutically will develop a transient thyroiditis, even though this may be subclinical with small or modest doses. Accompanying the thyroiditis there is usually a temporary increase in circulating thyroid hormone which may aggravate an already unfavorable cardiac status.

It is also understandable that in the patient whose heart is already compromised by the hyperthyroidism or an associated arteriosclerotic or hypertensive condition, these problems may be aggravated by the additional stress of surgery. For the above reasons it seems best to start treatment of older patients with an antithyroid compound and leave the decision regarding other therapy to a later date. Optimal control of the cardiovascular system disease will then have been established.

Thyrotoxic Myopathies

A certain degree of muscular weakness appears to be an integral part of the clinical picture of thyrotoxicosis. Its severity is not necessarily proportional to that of the underlying disease. Creatinuria and rather nonspecific cytological muscular changes accompany these clinical manifestations. Due to the loss of muscular power in relation to aging per se, these muscular problems of hyperthyroidism may be accentuated in the elderly patient. Any muscular weakness directly due to the thyrotoxic state is gradually and completely relieved by proper management of the hyperthyroidism. The myopathy of hyperthyroidism may take one of several forms, each generally appearing in an aggravated manner in the older subject.

Acute Thyrotoxic Myopathy

Acute thyrotoxic myopathy is a very rare disease, closely simulating myasthenia gravis of the bulbar type, even to the point of being relieved in part by prostigmine or one of its congeners. Unlike myasthenia gravis, it is completely relieved by thyroidectomy.

Chronic Thyrotoxic Myopathy

Chronic thyrotoxic myopathy is quite common and may be present in the majority of cases of hyperthyroidism. In its extreme or advanced forms, it is not easy to distinguish from myasthenia gravis, except by thyroidectomy, which has no influence on the latter disease, but relieves the thyrotoxic myopathy completely. The average age at onset is higher than that for thyrotoxicosis in general (Thorn and Eder, 1946), and men are more prone to the disease than women. Testicular atrophy occurs. Weakness and easy fatigability are the outstanding manifestations and may be so severe as to confine the patient to bed. Fibrillary twitchings have been observed. The shoulder girdle is most frequently affected, but no group of muscles is immune.

Cytological changes in the severe cases of chronic thyrotoxic myopathy include atrophy of muscle fibers with "fatty infiltration", loss of cross striations, lymphocytic reaction, and eventually fibrous tissue replacement.

On the basis of a low urinary excretion of neutral 17-ketosteroids and atrophy of the adrenal cortex and testicles, it seems justifiable to postulate that the myopathy results from a combination of thyrotoxicosis and steroid hormone deficiency (Thorn and Eder, 1946). Treatment may logically include attention to these facets of the disease.

The association of *myasthenia gravis* and *thyrotoxicosis*, while rare, may occur at any age, although it is more likely to be noticed prior to the age of 60 years than later. Differentiation of the two conditions is often difficult, as both may be temporarily relieved by neostigmine or other anticholinesterase agents. Therefore, should manifestations of the disease appear in conjunction with thyrotoxicosis, it is best to treat the latter condition adequately before drawing any conclusion concerning the presence of an independent myasthenia gravis.

Finally, it is a good rule of practice to treat all muscular disturbances appearing in thyrotoxicosis as an integral part of the hyperthyroid state unless by any acceptable means, complete control of the latter fails to relieve the muscular complaints in their entirety.

KNOWN HORMONAL SECRETIONS OF THE GLAND

Iodination of either tyrosine or thyronine is associated with the development of thyroid-like activity. In the case of tyrosine, such activity is only 4 percent of that seen with thyroxine (tetraiodothyronine). In the thyroid gland, thyroid hormone appears to be stored as a combination of thyroxine and globulin. The major circulating form is thyroxine, either free or bound to albumin and globulin fractions of the serum. A very small amount of hormone circulates as triiodothyronine, and this is believed to be the form to which the tissues best react. The amount of circulating hormone is said to decrease slightly with age (Pittman, 1962). There is no evidence to show any qualitative changes in the formation of hormone by the aged thyroid, although the total amount of hormone produced is obviously decreased.

AVAILABLE PREPARATIONS

Thyroidally active material is commercially available in 4 different forms: (a) Desiccated thyroid substance, probably containing a mixture of thyroglobulin, thyroxine, triiodothyronine and diodotyrosine; (b) Thyroid extract, which is a somewhat purified version of (a); (c) Sodium-l-Thyroxin; and (d) Triiodothyronine. All of these compounds are highly active in replacing thyroid glandular function. Triiodothyronine differs from the other compounds in being more rap-

idly active in the tissues. Otherwise, in proper dosage, any one of these compounds can be substituted for each of the others.

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THE ADRENAL CORTEX

ADRENAL SECRETION WITH AGING AND ASSOCIATED FUNCTIONAL CHANGES IN OTHER GLANDS

While some histological changes in the adrenal gland have long been recognized as an accompaniment of aging (McGavack, 1951; Hickler, 1962), significant changes in adrenosteroid secretion and excretion under normal and stressful conditions were slow to be recognized. Lack of functional tests with a high degree of reliability and accuracy may be the reason. The several steroid hormones secreted by the human adrenal can be broadly grouped into glucocorticoids, 17-ketosteroids, aldosterone, estrogen and gestagens (progesteroids).

Maintenance of the secretory activity of the adrenal cortex, except for the secretion of a major portion of aldosterone, is regulated by the pituitary hormone, ACTH (adrenocorticotropin). Larger amounts of ACTH are required to stimulate aldosterone secretion than are needed to evoke the secretion of glucocorticoids (Ganong et al., 1966). The major physiological regulator of the secretion of this steroid is probably found in the juxta-glomerular-renin-angiotensin mechanism of the kidney. It has already been noted that there is some direct evidence for a decrease in ACTH secretion with old age. Therefore, the secretory activity of the adrenal cortex is similarly affected, except for aldosterone.

Attempts to determine the amount of the several hormonal secretions of the adrenal under a wide variety of circumstances have been relatively uninformative. Our present knowledge of the changes with aging have resulted from studies of blood hormonal levels and urinary excretion titers. By far the most important of the glucocorticoids secreted by the adrenal cortex is 17-hydroxycorticosterone (cortisol), which is normally produced at rates of around 25 mgms. 24 hours

(Bondy and Altrock, 1953). It is largely due to the work of Pincus and his associates (Romanoff et al., 1961; Gherondache et al., 1964) that the secretory rates in relation to aging for C^{14} labelled cortisol have been studied. Latest estimates indicate that an average of 23.6 mgms. of cortisol are secreted from the adrenal cortex in young men, while "elderly individuals" secrete an average of 17.7 mgms. However, this decline appears to be directly related to muscular mass as can be determined by creatinine excretion. If the values are calculated in relation to muscular mass, the differential with age disappears as the younger individual shows an "adjusted" secretion of 14 mgms. and the elderly individual 15 mgms. The decrease in the urinary excretion of corticosteroid with aging has been found to be similarly related to muscle mass (Romanoff et al., 1961; Gherondache et al., 1964).

While total plasma 17-hydroxycorticosteroid (glucocorticoid) levels are within the normal range in patients over 65 years of age, the unconjugated fraction is cleared from the blood at a slower rate than in the subjects who are under 65 (Tyler et al., 1955; Samuels et al., 1957). There is also some indication that the unconjugated or free fraction of the 17-hydroxycorticosteroids is smaller in old age. Since this is the active fraction, this may further indicate a decreased usage of 17-hyrodxycorticosteroids in the older individual.

Further evidence for a decrease with age in the production of glucocorticoids is shown by the responses to ACTH of young as compared with older people. A 25 mgm. intramuscular dose of ACTH showed a 9 percent rise in glucocorticoids in the old as compared with a 21 percent rise in the young (Pincus, 1950). It must be concluded that glucocorticoid secretion by the adrenal and utilization by the body are both decreased in the elderly with the decrement directly related to the changing muscle mass.

It is indicated that "in the normal male, one-third of 17-ketosteroids are of testicular and two-thirds of adrenal origin." It was early recognized that decreases in plasma and urinary neutral 17-ketosteroids were among the most dramatic hormonal changes occurring from early middle life onward.

The two major androgenic metabolites appearing in plasma are dihydroepiandrosterone and androsterone. The combined average concentration of dihydroepiandrosterone plus androsterone in serum decreases from approximately 75 micrograms per 100 ml. in the third decade of life to approximately 5 to 6 micrograms per 100 ml. at age 60 to 65 or beyond. Urinary values decrease from 17.5 mgms. in 24 hours in young vigorous adults to approximately 5 to 6 mgms. in the same period of time in individuals beyond age 60. Inasmuch as only one-third of the urinary 17-ketosteroid precursors are secreted by the testes in the male, it is clear that age is associated with a loss not only of testicular precursors but also of a portion of the adrenal precursors. The decrease with age in circulating and urinary 17-ketosteroids is associated with a diminution of function of the gonads and a lowering of function in the adrenal cortex. The reduced secretion of thyroxine in the aged as a physiological adaptation to decreased requirements may play a role in diminishing the rate of excretion of both corticosteroids and ketosteroids (Evans, 1964). When thyroid hormone is reduced, the rate of cortisone degradation in the liver is also reduced and the blood concentration rises. The higher blood concentration tends in turn to suppress ACTH secretion and thus also the level of adrenocortical activity (Hickler, 1962). The decreased responsivity of the aging adrenal gland to ACTH administration may have its origin in such variables.

With age, the lowering of 17-ketosteroids arising in the adrenal cortex is due in part to a lowering of ACTH stimulation of the adrenal gland, which is responsible not only for producing glucocorticoids but also for producing adrenal estrogen and androgen.

Progesterone is produced in the adrenal cortex of young male subjects at a rate 2½ times that seen in the elderly (Gherondache et al., 1964). Unlike the values for glucocorticoids, this change in production rate is not quantitatively linked to creatinine excretion or to muscle mass. Inasmuch as progesterone is an intermediary in glucocorticoid, androgen, estrogen, and aldosterone production, its diminution well reflects the lowered function of the adrenal cortex during aging.

The secretion of aldosterone is much reduced in the aged. Young people 18 to 35 years old, have been found to have secretion rates for aldosterone (77 ± 7 micrograms per day) that are more than twice as high as those of elderly subjects with an average age of 75 years (34 micrograms per day) (Flood et al., 1967). Metabolic clearance rates and calculated plasma concentrations of aldosterone are also decreased in older people (Flood et al., 1967).

Important Clinical Implications and Applications

The above described changes in the activity of the adrenal cortex and the changes in the rate of secretion

of its steroid hormones in relation to age have several important clinical implications:

1. Aldosterone secretion is apparently not well maintained throughout life, but the pattern of secretion of tritium-labeled, intravenously administered, aldosterone is similar in both elderly and young subjects. Steroids with androgenic or estrogenic effect are most markedly decreased with age while the secretion of glucocorticoids is significantly but not as markedly depressed. It is difficult to escape the conclusion from such data that changes in adrenal glandular function with age represent active alterations and not passive degenerative processes. If this is so, then it would seem that the clinician may be in a position to change certain of these processes when it seems to the advantage of the subject as a whole. Here the difficulty lies in determining "cause and effect" relationships. If the changes in the adrenal are solely an accompaniment of more basic underlying senescent or aging processes, then altering them will produce no primary change in either the rate or the nature of aging. However, some of the usages to which adrenal secretions have been placed may lead one to believe that changes in adrenal cortex activity can be brought about to benefit the organism as a whole.

2. It has been possible to improve the clinical condition of subjects suffering from arthritis by the use of adrenocorticoids. In most instances it would seem that the dosage of such steroids has been larger than necessary (Jeffries, 1964). It must be remembered that their action is more preventive than reparative. In large dosages their untoward side effects may far outweigh the therapeutic benefits obtained. Attention should be given to utilizing the smallest doses possible (Jeffries, 1964; McGavack, In preparation). Dosages as small as 6 mgms. of cortisone daily or its equivalent in some other cortisone-like steriod can be extremely useful even in severe cases of arthritis, irrespective of the type. Such therapy should not be embarked upon lightly, for once begun it should probably be continued throughout the life of the individual, or until the arthritis is shown to be entirely quiescent, while the hormone is being slowly decreased.

At least a portion of the beneficial action of corticosteroids in arthritis may depend upon their ability to antagonize the action of growth hormone, which it has been inferred plays a causative role in the development of arthritis, particularly of the osteoarthritic type (Ansell and Bywaters, 1956; Blodgett et al., 1956; Hollander, 1960; Salmon et al., 1963). Growth hormone and glucocorticoids, while decreased in amounts available to the tissues during the aging process, are not as severely affected as some of the other hormones, such as thyroid hormone and gonadal steroids. Therefore, it may be possible by the judicious use of adrenosteroids favorably to influence conditions which may be produced by an imbalance between growth hormone and adrenosteroid hormones.

It is certain that many authorities will question the reasoning in the last few sentences, and more will challenge the results to be obtained with the modest steroid dose. Since corticosteroid therapy became generally available about 15 or more years ago, close association with aged subjects, some with severe rheumatoid and others with active mixed arthritis, leads us to believe that there is real value in the use of corticosteroid therapy planned along the general principles hinted at above. Those who expect dramatic, overnight results will be disappointed. The patient individual will usually be rewarded.

3. In relation to age, the anti-inflammatory and anti-allergic properties of the glucocorticoids are of major therapeutic concern. In addition to arthritis, intractable asthmatic bronchitis, with or without emphysema, represents one of the commonest indications for the use of an anti-inflammatory steroid. Itching dermatoses, though less dramatically affected, represent another condition of the aged which may call for the use of an anti-inflammatory steroid. It is not known that there has been any concerted effort to determine the amounts of circulating hormones or urinary excretion products in individuals with these diseases. The general feeling, however, is that no deficiency of steroid hormones exists in these conditions and that one is dealing with purely pharmacological, rather than physiological reactions when administering these drugs. Irrespective of cause and effect relationships, the above mentioned diseases, common in old age, do respond under very specific conditions to the utilization of a glucocorticoid, which often does not have to be employed in large doses for prolonged periods of time.

4. If doses of adrenosteroids are long continued at high levels there is a tendency to suppress thyroid activity (Hollander, 1960). Large doses of corticosteroids influence circulating TSH directly or block the mechanism by which TSH regulates iodine uptake. However, the lowered PBI and increased resin uptake of I^{131} following cortisone administration are believed to be due, in major part, to the expansion of serum

volume caused by cortisone (Blomstedt and Einhorn, 1967). In the present state of our knowledge, therefore, it seems unwise to follow any recommendations which advocate the employment of thyroid hormone in conjunction with long-continued corticosteroid therapy.

5. In developing their anti-inflammatory action, corticosteroids do not influence or inhibit antigen-antibody reactions nor the release of histamine-like substances. However, it is important to know that the crux of their action upon immune processes is a suppression of the reactivity of the tissues to the antigen-antibody union. The union is not prevented.

6. The side effects of corticosteroids should be studiously avoided. This can be accomplished in several ways:

a. By stopping the drug or materially decreasing dosage at the first signs of any untoward reaction. Perhaps the earliest and most constant evidence of toxic effect is the filling out of the face, always to be noted before frank "mooning" and plethora appear. If not too long maintained, this effect will decrease after the drug is stopped.

b. After using dosages sufficiently large to meet adequately the morbid processes present, reduction in dosages are in order and reductions should continue until the smallest dose that maintains the patient free of symptoms is used. If this proves to be above the suppressive dose of the hormone, then treatment should be carried out intermittently in order to avoid the late, long-standing or more severe reactions to the adrenosteroid.

The major bad effects include gastrointestinal ulceration; osteoporosis with or without fractures; infections—reasonably rare; necrotizing arteritis and thromboembolic phenomena. Most of these can be avoided if we observe the rule of dosage mentioned above.

With the older compounds, cortisone and cortisol, a number of very troublesome side effects may be frequently encountered; problems which are more severe in the aged than in younger individuals. We refer to the tendency for the long-continued use of these compounds to cause sodium and water retention, potassium loss, hypertension, edema, congestive heart failure, cardiac arrhythmias and so forth.

It appears that the newer compounds such as methylprednisolone, triamcinolone, dexamethasone and betamethasone are very much less liable to cause such complications. Indeed, it is possible to use the compounds with chemical alterations at carbon-atom 17 for the treatment of conditions associated with some of the above-mentioned manifestations. For example, congestive failure ceases to be an absolute contraindication to the use of such medication. The reduction of estrogen and androgen following or at middle or late middle life often leaves the patient suffering from climacteric manifestations. Here, the suitable addition of estrogen or androgen as mentioned under "The Gonads" will be sufficient to bring about a readjustment and a better state of health. In using these steroids, however, one must keep in mind that they are water and salt-retaining and must therefore be used carefully, if at all, in severe congestive failure, in renal disturbances with edema and so forth. If congestive failure is not present, it is probably well to employ a small dose of thyroid hormone simultaneously with the estrogen or androgen.

7. In connection with aging, there seems to be no place for aldosterone-type therapy except in Addison's disease. Aldosterone secretion is normally decreased in old age; however, in conditions in which hypertension is present or severe congestive heart failure occurs, an increased excretion of aldosterone is usually found. If this is the case, spironolactone may be tried, 100 mgms. daily in four divided doses.

DISEASES OF THE ADRENAL CORTEX IN THE AGED

Presently known diseases of the adrenal cortex may occur at any age and therefore appear not to be too closely associated with any single period of life. However, several conditions may be profitably considered in relation to aging and its problems.

Cushing's Syndrome

The highest incidence of spontaneous Cushing's occurs during the third and fourth decades of life. Iatrogenic or secondary Cushing's syndrome is a frequent condition of older people, particularly those with arthritis, who have been overtreated with a glucocorticoid. The iatrogenic form of the disease may also occur in the course of treating lupus erythematosus, periarteritis nodosa, dermatomyositis and other so-called collagen diseases, as well as skin conditions such as erythema multiforme bullosum and generalized exfoliative dermatitis. It seems unfortunate that the secondary form of Cushing's syndrome should most commonly be seen in arthritis where there is little or no

justification for overdosage at any time. When needed at all, the therapeutic action of 11-oxycorticoids can be well used advantageously in arthritis without producing Cushingoid features. The clinical manifestations of the iatrogenic disease are identical with those of the spontaneously occuring condition. Fortunately, these manifestations will all disappear if the drug is discontinued. Major disturbances can usually be avoided by keeping the dosages low.

In discussing Cushing's syndrome in the aged, it must be kept in mind that cortisol and its congeners can themselves cause a systemic lupus erythematosus-like picture or a periarteritis nodosa-like picture when long continued, particularly in larger doses. Such cases are mistakenly diagnosed as the condition which they simulate and incalculable harm has often been done by adding more steroid to the therapeutic regimen.

Hyperaldosteronism

The secretion of aldosterone appears to be normally under the control of the juxta-glomerular apparatus, activity of which in some way favors the release of renin from alpha 2-globulin. This acts upon the angiotensin (I) angiotensin (II) mechanism to stimulate the production of aldosterone. Some physiological factors concerned with aldosterone secretion should be mentioned.

1. A restriction of sodium intake stimulates aldosterone section. Sodium restriction must, therefore, be looked upon as a very powerful stimulus to aldosterone formation and release.

2. Anything which decreases the fullness of the blood vessels will stimulate the secretion of aldosterone —loss of blood, constriction of the inferior vena cava, edema in the presence of albuminuria and so forth.

3. An increased intake of potassium or a rise for whatever reason in plasma potassium levels will serve as a stimulant to aldosterone secretion.

Excesses in aldosterone secretion may be primary in the adrenal, resulting from adenoma, carcinoma or hyperplasia of the adrenal cortex and/or they may be secondary to malignant hypertension, cardiac failure, nephrosis and cirrhosis. The primary disorders are rare and, while seen at any age, are most commonly observed between puberty and the seventh decade, while secondary hyperaldosteronism is relatively common and more often found in older than in younger people.

Primary Hyperaldosteronism

This is usually due to a single adenoma of the adrenal cortex which may vary widely in size but usually weighs between 1 and 3 gm. A condition due to bilateral hyperplasia of the adrenal cortex has been seen only in the young.

The major clinical feature of primary hyperaldosteronism is the potassium deficiency, the secondary effects of which include weakness, episodic paralysis, paraesthesias, tetany, thirst and polyuria. Clinical evidence of sodium retention is not present. The low plasma potassium cannot be easily corrected with potassium supplements. Ideally, the diagnosis is confirmed by an abnormally large urinary excretion of aldosterone.

Secondary hyperaldosteronism

Hyperaldosteronism of the secondary type occurs whenever sodium depletion or potassium excess occurs. The adrenals secrete large amounts of aldosterone in cirrhosis of the liver and other hepatic disease, nephrosis, cardiac failure, and in certain cases of hypertension.

Pheochromocytoma

The average age of patients with pheochromocytoma lies close to 45 years but a significant number do not become symptom-producing until much later (Gifford et al., 1964). There are two major clinical types of the disease: (a) that with episodic attacks of hypertension associated with severe sympathomimetic manifestations, particularly tachycardia, pallor, sweating, dizziness, headaches, fainting and sometimes cardiac failure and even death; and (b) continuing sustained hypertension which must be differentiated from other forms of essential hypertension by objective means.

Confirmation of the diagnosis by appropriate tests is essential. The most helpful and now standard quantitative diagnostic tests are the determinations of urinary excretion of catecholamines [norepinephrine (NE) and epinephrine(E)] and their metabolites.

When the presence of a pheochromocytoma has been established, the question of localization of tumor site arises. Since 99 percent of patients will have their tumors within the abdominal cavity and since, at operation, every part of the abdominal cavity must be explored, all unnecessary preoperative procedures should be eliminated. The definitive therapy for pheochromocytoma is surgery, because 99 percent of the patients have benign tumors and, with good preparation, are reasonably good surgical risks. In the preoperative management of the patient, control of the hypertensive crises can usually be obtained by the

proper use of the alpha-adrenergic blocking agent, phenoxybenzamine (Dibenzyline). A more logical pharmacological approach to pheochromocytoma would be to utilize agents which will block catecholamine production. Among these, tyrosine hydroxylase inhibitors offer great promise.

AVAILABLE PREPARATIONS OF ADRENOCORTICOSTEROIDS

Glucocorticoids

A wide variety of satisfactory preparations of glucocorticoids have been made available for use topically, orally and parenterally. Commonly employed have been the parent compounds, cortisone and hydrocortisone, which represent the only naturally occurring steroids in this group. Through various modifications of chemical structure, prednisone, prednisolone, methylprednisolone, triamcinolone, dexamethasone and betametasone have been subsequently produced. All of these compounds are powerful adrenocortical hormones and, as is the case with most potent drugs, have many side effects. Major differences in the incidence of side effects appear only in relation to water and salt retention. It appears that triamicinolone, dexamethasone and bethamethasone show less tendency for such action than do the other compounds, while prednisone and prednisolone may assume an intermediate position between cortisone and hydrocortisone on the one hand and the three first mentioned compounds on the other. These quantitative differences are based on equivalent anti-inflammatory and anti-allergic effects.

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THE GONADS

GONADAL SECRETION WITH AGING AND ASSOCIATED FUNCTIONAL CHANGES IN OTHER GLANDS

The gonads in both sexes achieve maximum size somewhere between the fifteenth and twentieth years of life and attain maximal functional activity between 25 and 35 years of age. Failure in ovulation which signals the menopause in women seems to be primarily a loss of responsivity on the part of the ovary, so that pituitary hormones are no longer capable of stimulating the maturation of the individual ovum. There is, indeed, at this period of life an increase in pituitary activity rather than a decrease. In the male, the situation is quite different, as the germinal cells of the testes do not involute or lose their function rapidly or abruptly. Nevertheless, as in the female, there is a final diminution in the production of germ cells, at a time when pituitary-gonadotropic activity is usually high.

From middle life onward in women there is a marked decrease in the urinary excretion of total estrogen—from an average of 38.2 RU/24 hours in early adulthood to 6.7 RU/24 hours about age 60 (Pincus et al., 1954; Pincus, 1956). At first there is a decrease in all three estrogen fractions with the magnitude of the change being greatest for estriol and least for estrone, while estradiol occupies an intermediate position.

After 60 years of age, the relatively constant total value for estrogen in the urine is due to an increase in estriol with a slight decrease in the hormonally more active substances, estradiol and estrone.

In the male, excretion of estrogen is rather constant throughout adult life, with an average of about 12 RU/24 hours. There is, however, throughout this period a steady but slight decline in the values for estrone and estradiol with a corresponding rise in that for estriol.

While the menopause in women is by many considered synonymous with the climacterium, these two events should be sharply distinguished. The menopause is a normal event in the life sequence of every woman associated with a decline in gonadal function dramatically signalled in by the cessation of menstruation and accompanied by an orderly readjustment of glandular activity. On the other hand, the climacterium in both the male and female represents a failure in the readjustment of interglandular activities before, during or after the menopause in the female, and at some time during middle or late middle life in the male.

Although this condition may be more common in women, it is certainly present in a significant percentage of both men and women. As many as 15 percent of all women suffer from some degree of climacteric disturbance. While the percentage may be slightly less in men, it is the impression that at least 5 out of every 100 men undergo some degree of glandular maladjustment at this time of life which gives rise to unpleasant subjective and objective manifestations.

The hallmarks of the female climacterium need no reiteration here and can be promptly relieved in a majority of patients by the use of estrogen in moderate doses (for instance, 0.01 to 0.02 mgms. ethinyl estradiol daily by mouth or its equivalent in some other active estrogenic preparation), or by a combination of hormonal materials which should include estrogen and desiccated thyroid substance with adrenal cortex hormones added in small dosage for *short periods* of *time* if necessary. Testosterone may be occasionally needed, but all of these materials should be well indicated before employed.

The waning function of the ovary before, at, or/and beyond the menopause is presumed to initiate specific changes in the pituitary gland of a histologic and functional nature. Only the functional changes need concern us here. They include an increase in follicle-stimulating hormones (FSH), a diminution in luteinizing hormone (LH) and a loss of luteotropic hormone (LTH). The increase in FSH is commonly thought of as due to a loss of the feedback mechanism by which estrogen normally controls the amount of FSH produced. Other workers feel that the increase in urinary gonadotropins excreted at this time of life is due to an under-utilization of the material by the ovary rather than to its overproduction by the pituitary. In any event, the increase in the amount of gonadotropin in the pituitary and in the urine is commonly seen in women, less commonly in men, but with or without climacteric symptoms in both sexes.

The luteinizing hormone produced at this time of life apparently serves to stimulate the production of estrogen and androgen by the adrenal cortex. Thus, the production of these materials by the adrenal cortex is little, if at all, affected by age in either sex.

If the changes in the gonad of the female at the climacterium were simple degenerative ones, it seems doubtful that there would be an increased activity in

other areas of the body resulting in some degree of compensation for the gonadal loss. Therefore, the qualitative differences appearing during aging in relation to the decreasing gonadal function tend to confirm the concept that aging is an active rather than a passive process and, as such, should be capable of regulation wherever our knowledge is sufficient and the necessary preventive or remedial tools are at hand. Shipley has called attention to the fact that it may be easier to prevent some of the changes of the climacteric than to cure them (Shipley, 1962). He is referring specifically to osteoporosis. It seems possible, however, that other effects of maladjustment in hormonal function in middle life may also be prevented or retarded by proper therapy.

In normal young men, the mode for the 24-hour urinary output of 17-ketosteroids appears to lie between 15 and 20 mgms., while after 65 years of age it is between 6 and 10 mgms. (Kenigsberg et al., 1949). While values for women decrease, they decrease at a lesser rate, probably because most, if not all, of the precursors in women are synthesized by the adrenal cortex. In younger women, the mode of excretion ranges between 11 and 15 mgms. daily, while in the old it lies between 5 and 9 mgms.

Qualitative, as well as quantitative differences of significance in urinary 17-ketosteroid excretion are found between the young and the old individual. Androsterone and etiocholanolone, major urinary excretion products of testosterone, are present in the urine of the normal young adult in a ratio of approximately 3 to 2 (Gallagher et al., 1960). In the older individual this ratio is usually reversed.

From studies of adrenal venous blood, Wieland and his associates (Wieland et al., 1965) have concluded that testosterone is a very minor adrenal precursor of urinary neutral 17-ketosteroids. Lipsett and his associates (Lipsett et al., 1966) have observed plasma levels for testosterone around 1.0 micrograms per 100 ml in men about 21 years old and an average value of 0.70 micrograms per 100 ml in men between 30 and 45 years of age. Kent and Acone (1966) state that the plasma values for testosterone are relatively constant throughout the first 8 decades of life since they found a mean value of 0.56 micrograms per 100 ml in 68 men ranging in age from 20 to 93 years of age. They believe older men produce less testosterone than younger subjects but maintain plasma levels found in earlier life because of a lessened utilization. Maintenance of plasma levels—from whatever cause—may explain the lack of sharp increases in urinary gonadotropins in most aged men.

Estrogen has been shown to have an inhibitory effect upon the secretory activity of the adrenal cortex, except for its production of gonadal corticoids (Soffer et al., 1961). It also has a highly selective differential action upon the gonadotropins of the pituitary (Parlow, 1964). Androgen in large doses has been known to inhibit the secretion of growth hormone, particularly in hyperpituitary states (Williams, 1962; McGavack, unpublished). Teleologically viewed, this fact may indicate that the loss of gonadal function in middle or late middle life removes a normal brake on the production of growth hormone by the pituitary. It thus leaves intact a mechanism concerned with the repair and maintenance of protein in all tissues of the body. This can scarcely be looked upon as a simple degenerative process. Moreover, it can obviously be influenced by the administration of hormone if the quality and method of administration are correctly adjusted.

IMPORTANT CLINICAL IMPLICATIONS AND APPLICATIONS

Thought-provoking, although certainly of no practical value, is the suggestion that both osteoarthritis (Salmon et al., 1963) and diabetes mellitus in the elderly have at least part of their cause in the loss of a brake to growth hormone production and utilization. If this be true and if the production of adrenocortical hormones is simultaneously increased, the tendency to diabetes mellitus may be greater, while the tendency to arthritis may be less.

This is scarcely the place to discuss at any length the climacterium in either the female or the male. For its treatment, there are seemingly some physicians who would advise a fireside chat "coupled with a sympathetic prescription of a mild sedative" (Israel, 1962). Fortunately, few men experience the severe vasomotor disturbances commonly seen in the female with this condition or there would be less of this type of advice. The female climacterium has as its major group of symptoms vasomotor phenomena with palpitation, vertigo, scotomata, hot flushes, sweating and breathlessness. These phenomena which may be accompanied by excessive nervousness and irritability manifest themselves usually as emotional instability and can go on to depression, impairment of memory, inability to concentrate and even to anxiety, agitation and apprehension.

Foremost in the male climacteric is easy fatigability, weakness, muscular aches and pains and nervous phenomena which are usually manifested by difficulty in concentration, loss of memory, restlessness, insomnia and irritability "without cause" (McGavack, 1955b). To a lesser degree, the vasomotor phenomena may occur. In both sexes, vague muscular aches and pains call attention to the locomotor system. These people are often mistreated for arthritis, when simple substitution therapy with a gonadal steroid would completely relieve them. The muscular aches and pains are in part due to actual weakness of the musculature. Not only are there the arthritic and periarthritic disturbances, but in the urological sphere, decreased force of the urinary stream and dragging pains in the groin, both of which may have their origin in the muscular weakness. Constipation and bloating seen in both sexes appear to have a common cause. Nothing gives more satisfactory relief of the manifestations of this condition than the usage of properly balanced hormonal therapy.

The loss of gonadal steroids in middle or late middle life is commonly blamed for the frequency with which osteoporosis occurs. There is certainly proof now that estrogen stimulates fibroblasts and specialized forms of fibroblasts such as osteocytes, wherever they may occur (Kao et al., 1964). However, there is no really satisfactory proof that gonadal hormones can cure osteoporosis, although it is suggested that they may prevent it. Indeed, there are those who believe that osteoporosis is not caused by changing titers of gonadal steroids in the tissues but rather by changing needs and availability of calcium and phosphorus for the fabrication of bone. Much more work is needed in this field.

The close relationships shown to exist between gonadal and thyroid function (Boccabella and Alger, 1964; Ferrer and McGavack, 1953; Gallagher et al., 1960; McGavack et al., 1955 (a); McGavack and Seegers, 1956, 1959) raise the possibility that when we are adjusting glandular relationships post-menopausally by hormonal therapy, we may find it appropriate to consider using gonadal steroids and thyroid hormone in conjunction one with the other. However, there are no simple or "hard-and-fast" rules for approaching such problems. Each person must be considered individually and therapy carefully geared to the findings present.

KNOWN HORMONAL SECRETIONS

It is probable that estrogen is produced by the ovary chiefly, if not solely, in the form of estradiol, although estrone has been shown to be present in small amounts. Both the ovary and the testes produce estrogen and androgen, the major, if not the only, androgen being testosterone. In women prior to the menopause, the production of estrogen predominates, while in the male there is more testosterone than estrogen. In middle or late middle life, the differences between the secretions in the two sexes tend to disappear.. The lessened amounts of these steroids remaining serve chiefly an anabolic function, with very little or no sex-linked action.

AVAILABLE PREPARATIONS

Estrogens commercially available are of three different types:

A. Synthetic materials with chemical structures similar to, but not identical with normally occurring estrogens, of which stilbestrol is the commonest example.

B. Synthetic preparations identical in chemical structure with normally occurring estrogens, of which estradiol is our most potent material.

C. Naturally occurring estrogens derived from animal sources which include estradiol, estrone and estriol, of which the first two are clinically useful.

All of these preparations can be effectively given by mouth. There is, therefore, little need for the use of parenterally administered materials.

Commercially available androgens include testosterone and its many chemically closely related compounds, particularly methyltestosterone. All of the preparations of testosterone and its derivatives can be given either orally or bucally. While testosterone is not very effective orally, its methyl derivative can be quite usefully employed. Various changes in the testosterone molecule have been credited with favorably altering the metabolic effect while depressing sex-linked actions. The claims for such favorable differential action, an action which would be most useful in elderly individuals, still do not rest on the most secure of grounds. However, without attempting to appraise their relative values in this regard, the following drugs have been marketed on claims that their anabolic actions far outweigh their sex-linked effects: oxymetholone, methandriol, methandrostenolone, nandrolone, norethandrolone, stanozolol and dromostanolone.

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PARATHYROID GLANDS

FACTORS GOVERNING HORMONE SECRETION

The parathyroids are believed to attain their maximal size early in childhood and together weigh from 100 to 130 mg. throughout life. The chief cells, which produce parathyroid hormone, are the preponderant component of the glands before puberty. Their secretory activity appears to be regulated primarily by the activity of the calcium ion in plasma. At, or after puberty, 2 new elements appear: the oxyphil cells with *no* known hormonal purpose; and islands of fat cells between the cords of parenchymal cells. The physiological significance of these changes is not known.

The rate of secretion of parathyroid hormone appears to be an inverse function of plasma calcium levels (Albright and Reifenstein, 1948; Howard, 1957). The gland is believed to maintain its capacity for response throughout life, except as this response may vary in relation to alterations in the secretory level of other glands.

INFLUENCE OF HORMONES OF OTHER GLANDS ON PARATHYROID SECRETION

Many endocrine as well as non-endocrine influences are brought to bear, for the most part secondarily, upon the production of parathyroid hormone. An excess of the 11-oxyadrenocorticoids tends to lower serum calcium levels and to shunt protein away from bony matrix, which results in secondarily decreasing the amount of calcium laid down in bone. In the presence of diabetes mellitus, the above action is enhanced. Osteoporosis may result. In the normally aging, overt osteoporosis is rarely seen, as the amount of available 11-oxyadrenocorticoids is slightly lowered (Ramonoff et al., 1961; West et al., 1961; Pincus, 1956). However, in some abnormal states, e.g., specific

types of hypertension, arthritis, abnormal climacterium and so forth (McGavack, 1951), corticoid production may be relatively high.

Sensitivity to the action of parathyroid hormone varies directly with the level of thyroid hormone utilization (Reifenstein, 1961).

Thyrocalcitonin, a relatively small peptide from the parafollicular cells of the thyroid, is known to lower serum calcium and phosphorus. It probably plays an important role in indirectly regulating the normal secretion and activity of the parathyroid hormone. Its physiological importance is not yet fully appreciated.

Gonadal steroids act to increase the formation of bony matrix and calcium deposition through stimulation of osteoblastic activity while parathyroid hormone increases bony resorption and calcium mobilization by stimulating osteoclastic activity. Therefore, the diminished production of both estrogen and androgen in middle or late middle life is accompanied by decreased bony formation and a tendency for increased loss of calcium from bone.

IMPORTANT CLINICAL IMPLICATIONS AND APPLICATIONS

Primary hyper- and hypoparathyroidism are relatively rare and may occur at any age.

Hyperparathyroidism

Single or multiple adenomas are the cause of hyperparathyroidism in about 90 percent of the cases. Of these, 10 percent may be found in unusual locations—glands of the mediastinum, thyroid, behind the esophagus. The diagnosis is often not an easy one. It should be suspected until ruled out, if hypercalcemia and/or hypophosphatemia are present. General manifestations of metabolic disturbances and evidence for osseous and renal disease are confirmatory.

General symptoms, that is, those associated with hypercalcemia and/or protein catabolism are common manifestations of many diseases but are rarely brought together in so striking a manner as in hyperparathyroidism. A primary feature is a decreased excitability of neuromuscular structures due to the hypercalcemia. As evidence of this action we see general muscular weakness and hypotonicity resulting in constipation, anorexia, nausea (even vomiting), crampy abdominal pain, dryness of mucous membranes of the nose and occasionally dysphagia. Loss of weight, fatigue and apathy may accompany.

Disturbances of calcium metabolism may give rise to numerous irregularities and, possibly, even psychotic manifestations. Polydipsia and dehydration may occur. When bone disease is present, pain in the bones and pathological fractures are common. Renal involvement is primarily a result of the hypercalciuria and hypophosphaturia. Nephrocalcinosis, with or without large calculi, is usually present. Renal colic and hematuria may be the first symptoms to attract the attention of a clinician. The hypercalcemia is reflected in the electrocardiogram, particularly by shortening of the Q–T interval. Widespread metastatic calcification may occur not only in the kidneys but in other areas where the pH favors the deposition of calcium salts.

Bone disease may take the form of generalized decalcification or the development of bone cysts. Osteitis fibrosa generalisata is the classical form, although it must be remembered that the disease can exist with no bone disturbance apparent radiographically. The disease must be differentiated from other diseases of bone in which disturbances of ossification are present. The treatment of primary hyperparathyroidism is always surgical. Enough parathyroid tissue should be left to meet normal physiological needs. As a general rule 100 to 150 mgms. of normally functioning tissue can fill such requirements.

Hypoparathyroidism

The commonest cause of hypoparathyroidism is damage to or removal of the parathyroid glands in the course of surgery upon the thyroid gland. The condition usually makes itself known within several days to 2 weeks after operation and may at first appear as an aggravation of some of the hyperthyroid symptoms for which the operation was done. In other instances, onset of the hypoparathyroid state may be delayed for many years.

Primary or spontaneous hypoparathyroidism is found mostly in children and more often in girls than in boys. No reason has yet been found, although the condition sometimes runs in families. Some observers believe that postoperative hypoparathyroidism occurs in about 1 percent of patients operated for thyroid gland disease. In hypoparathyroidism, we have a state in which there is too little, rather than too much serum calcium, with a lowering particularly of the ionizable calcium present. Therefore, there is hyperexcitability of the neuromuscular apparatus with a wide variety of manifestations attributable to this fact alone.

The diagnosis is usually easy if the condition is suspected. A low serum calcium with a high serum phosphorous will usually clinch the diagnosis. Where these are within normal range the abnormal responses to calcium tolerance tests may provide confirmatory information.

Treatment focuses upon ways and means of raising the level of serum calcium. In the acute condition where tetany is a prominent feature associated with hypocalcemia and alkalosis, vigorous measures are indicated. The intravenous infusion of 10 cc. of a 10 percent aqueous solution of calcium gluconate will usually relieve the tetany. However, one should be cautious in employing this where the patient is receiving digitalis; cardiac standstill has been known to occur. As soon as the tetany is controlled, long-range therapy should be contemplated.

From a practical standpoint the best single drug is dihydrotachysterol, which aids not only in the absorption of calcium but also in its distribution. As a general rule, 3.75 mgms. (3 cc.) daily will be sufficient, particularly if some calcium supplement is continued. The Sulkowitch test (Ritter et al., 1960) should be performed daily on the urine (a test the patient can learn easily) and subsequent treatment with calcium and dihydrotachysterol adjusted to show only the slightest reaction.

For long-term usage in more severe cases the patient should be advised to follow a diet which is high in calcium and low in phosphorous. This unfortunately rules out milk, as it is high in both calcium and phosphorous. The same applies to cheese and other milk products as well as to egg yolk. If these foods are avoided and a calcium supplement is given, such as calcium gluconate or calcium lactate along with the dihydrotachysterol, the patient usually does well. If the high-calcium, low-phosphorous intake is to be used, progress must be followed with periodic determinations of serum calcium and phosphorous and these kept within satisfactory range.

KNOWN HORMONAL SECRETION OF THE GLAND

Parathyroid hormone appears to be a polypeptide, obtainable in relatively pure form by extraction of the parathyroid glands.

COMMERCIALLY AVAILABLE PREPARATIONS

Parathyroid hormone is commercially available under the generic name, parathormone.

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THYMUS GLAND

CHANGES IN THE THYMUS WITH AGE

Maximum gland weight/body weight (GW/BW) ratio occurs at birth. The average weight of the gland at that time is 12 gm. The maximum gland weight (MGW) occurs at puberty, 35–40 m.

At, or shortly after puberty, there is rapid atrophy of the thymus with fatty replacement of glandular tissue. The structure may weigh as little as 6 gms. in late life. This atrophy is reversible and therefore, in the strictest sense, is not a degenerative process. The thymus has a very active role to play in the development of non-

specific immunity during the early months of extra-uterine existence, a purpose which it decreasingly serves until at or shortly before puberty. This function may be identical with that of the lymph glands and similarly activated. There is evidence to suggest that a humoral thymus mechanism is involved in the maturation of immunologic capabilities (Miller, 1964). In addition, the gland may have endocrinous secretion(s), as early work has indicated (Park and McClure, 1919; Grollman, 1947) but their existence is doubted by many (Hoskins, 1956).

INFLUENCE OF HORMONES OF OTHER GLANDS UPON THE THYMUS

Increases in thyrotropin cause hypertrophy of the thymus at any time of life (Rawson, 1949). Gonadal steroids and 11-oxyadrenocorticoids produce atrophy (McGavack, 1951). In gonadal or adrenocortical deficiency, an increase in thymic activity may be observed.

IMPORTANT CLINICAL IMPLICATIONS AND APPLICATIONS

Hypertrophy, metaplasia and even neoplasia of the thymus are seen in myasthenia gravis and in hyperthyroidism. The muscular weakness seen in these conditions may be related to the thymic involvement. A proven role of the thymus in specific or nonspecific disturbances of gamma globulin has never been demonstrated. The decline of thyroid function in aging carries with it a further loss of thymic activity and a decrease in the efficiency of its role in immune processes.

KNOWN HORMONAL SECRETION(S) OF THE GLAND

No endocrine secretion of the thymus has been isolated.

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Section B

CLINICAL PROBLEMS CLOSELY RELATED TO MULTIPLE ORGAN SYSTEMS

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SECTION B/CLINICAL PROBLEMS CLOSELY RELATED TO MULTIPLE ORGAN SYSTEMS

Part X/Metabolic Diseases and Disorders

DIABETES MELLITUS IN THE AGED

By

Leo Gitman, M.D.

INTRODUCTION

Diabetes in the aged deserves special consideration because: (1) more diabetics are surviving to old age; (2) more people are reaching the age group (sixth decade) of highest incidence of diabetes, moreover one-half of diabetics are detected between the ages of 40 and 60; and (3) the elderly comprise the age group with increased incidence of degenerative diseases which are accelerated by diabetes.

Since the introduction of insulin, deaths from diabetes in individuals under 50 years of age have shown a marked decline, whereas in the older age groups, mortality from this cause has increased. This, very likely, is due to the very common coexistence of the diabetic state with those degenerative diseases seen in older individuals. The greatest concern in management, therefore, has to do with the high incidence of complications, rather than the diabetes itself which generally is managed with little difficulty.

In dealing with the elderly, as with all age groups, the physician must always be aware of the importance of a strong familial history of diabetes.

There is little question of the importance of obesity in the aged diabetic. At least one-half of older diabetics are overweight and often provide a history in which they report having gained weight in the period shortly before symptoms of diabetes became manifest. It should be noted that this is the reverse of what is seen in younger diabetics. Some authorities estimate that the mortality rate among underweight older diabetics is one-twentieth that of the obese.

DIAGNOSIS

When a patient presents himself with thirst, polyuria, and glycosuria, the diagnosis of diabetes offers little difficulty, and corroboration by the laboratory is the rule. In the young diabetic, i.e., the juvenile type, the disease is characterized by a relatively acute onset of polyuria, polydipsia, thirst, weight loss, ketosis and sometimes coma. In the aged ("maturity onset type"), the onset is most likely gradual and mild, and the patient may present himself with the signs and symptoms of a complication rather than those of diabetes itself. Any aged individual with renal disease, retinopathy, neuropathy, or peripheral vascular disease should be suspect, especially if he is obese and there is a family history of diabetes.

Fasting Blood Sugar

The expectation of glycosuria is less dependable in the aged than in younger individuals and it may be absent even in the presence of hyperglycemia. Also, since diabetes in the great majority of older people is mild in character, a fasting blood sugar level which may be low enough to be accepted as normal does not necessarily exclude the disease. To confuse the picture more, published data indicate that in nondiabetic older people, there is a small increase in fasting blood sugar values with increasing age.

In an attempt to partially resolve some of this confusion, the following scale of fasting blood sugars may be generally followed and found useful: 110 mg.% or below—normal level; 110–130 mg.%—equivocal level and further study required; greater than 130 mg.% —highly probable diabetic level.

Postprandial Blood Sugar Test

The routine use of a 2-hour postprandial blood sugar test is preferable to determination of blood sugar in the fasting state only and the yield of positive case finding is substantially higher, particularly among those with mild diabetes. A standard 100 gram carbo-

hydrate meal of the following composition is suitable: 8 oz. of fruit juice; 3 slices of bread with 3 teaspoons of jelly; 8 oz. of milk or tea or coffee with 2 teaspoons of sugar. Under these conditions, the following scale for the 2-hour blood sugar may be generally accepted and found useful: 110 mg.% or below—normal value; 110–140 mg.%—equivocal value; greater than 140 mg.%—highly likely diabetic value. Unfortunately the above scale may yield a good many false positive diagnoses in the aged, and it is best to have a standard glucose tolerance done whenever values are in the equivocal range or only slightly greater than 140 mg.%.

Oral Glucose Tolerance Test

An oral glucose tolerance test should be performed if the 2-hour postprandial blood sugar level is equivocal. In preparation for this the patient should consume a diet containing at least 300 gms. of carbohydrate daily for 3 days (5 days if the patient has been on a restricted diet) prior to the test, which is performed in the standard manner. The commonly accepted criteria for interpretation of the oral glucose tolerance test are as follows:

	Blood sugar		
	Normal values (maximum) *(mg. %)*	Borderline values (maximum) *(mg. %)*	Diabetic values (minimum) *(mg. %)*
Fasting.....	110	110–120	120
1-hr.....	160	160–170	170
2-and 3-hr....	110	110–120	120

It is unfortunate that these limits also cannot take into account age-related changes in glucose tolerance. Many published reports indicate there is a higher peak and increased delay in return to the fasting level in nondiabetic aged subjects when compared to nondiabetic younger people. Others find no age-related change. The usefulness of these data is further questioned by reports indicating that there may be fluctuations in the configuration of the glucose tolerance curves obtained from tests which have been repeated at intervals in the same individual. These range from normal curves to those that are frankly diabetic in type, with many in intermediate value zones. Since the oral glucose tolerance test is a result of absorption, storage, and peripheral utilization of glucose, any age-related impairment of one or more of these processes, though unrelated to diabetes, may produce abnormal curves. This disturbing variability in part may be due to the lack of an adequate diet of the older person, especially with respect to carbohydrate prior to the test. An antecedent restricted carbohydrate intake can result in "false positive" curves.

At the present stage of our knowledge, the most logical approach is to use the above figures as guides in the selection of criteria for normality or otherwise. Gross deviations, of course, present no diagnostic problems. It is safest to say, however, that lesser deviations should be best considered abnormal, and under these conditions the older person managed as a diabetic despite the lack of a clearcut diagnosis. To avoid any undue emotional stress, the patient might be told that he has a "tendency to diabetes" and assured that adherence to a proper diet is all that is necessary.

COMPLICATIONS

It is important to realize that in the aged, the complications of diabetes may exist in the absence of overt evidence of the disease, i.e.: hyperglycemia and glycosuria. Certainly in the presence of a familial history of the disease, adequate study should be undertaken.

Although a large number of complications of diabetes have been reached, those most commonly seen in the aged may be listed as follows:

Vascular
- Peripheral vascular disease
- Coronary artery disease

Renal
- Intercapillary glomerulosclerosis (Kimmelstiel-Wilson disease)
- Papillary necrosis

Ophthalmic
- Retinopathy
- Cataracts
- Glaucoma
- Extraocular muscle palsies

Neurological
- Peripheral neuritis
- Neuropathic ulcer

Vascular Complications

The early development of atherosclerosis in diabetic individuals is well known to all. In the aged, clinical manifestations of vascular disease in two locations have particular meaning.

Peripheral Vascular Disease

The incidence of gangrene in aged diabetics, which is due to occlusive vascular disease, is many times greater than in nondiabetics of the same age. The decrease in sensory perception, which is so common and probably accentuated by neuropathy, results in an increased risk of local trauma which in turn may give rise to ulceration and gangrene. The all too frequent ignorance of the aged diabetic concerning proper foot care is another potent reason for the high incidence of gangrene in these people.

There are other factors which appear with frequency in the aged diabetic, often in association with peripheral vascular disease. Principal among these are obesity, varicosities of the lower extremities, and dependent edema due to either cardiac or renal failure. These factors add materially to the anoxia of the lower extremities created by peripheral atherosclerosis, and help to set the stage for tissue necrosis.

Coronary Artery Disease

Ordinarily, coronary atherosclerosis is an uncommon clinical finding in nonhypertensive women before the age of 60. Middle-aged diabetic females, however, lose this immunity conferred by their sex, and in the absence of hypertension, a female with clinical coronary artery disease should be highly suspect of having diabetes. This particular fact supports the generally accepted view that atheromatogenesis is materially influenced by disorders in carbohydrate metabolism.

Renal Complications

Intercapillary glomerulosclerosis (*Kimmelstiel-Wilson disease*) is the most important renal complication of diabetes and is now generally accepted as a specific lesion occurring in the disease. It is believed that almost all diabetics who are examined at postmortem will demonstrate pathological evidence of this renal disease. Clinical evidence, however, is apparent very much less frequently, and only about 1 in 10 develops a true nephrotic syndrome. Since intercapillary glomerulosclerosis requires substantial time for development, it is of expected increased occurrence in older people.

Papillary Necrosis

This condition is uncommon in the aged but is life-threatening when it does occur. It seems to be related to poorly controlled diabetes and probably is the result of many factors, including infection and obstruction.

Ophthalmic Complications

Retinopathy

The presence of microaneurysms is believed to be indicative of diabetes, even in the absence of hyperglycemia and other stigmata. Funduscopic examination must be an integral part of periodic health evaluation in the aged, and is particularly important with reference to diabetic detection and in observing the course of the disease.

Cataracts and Glaucoma

The specific nature of cataracts and glaucoma in the diabetic are of no significant difference from those in the nondiabetic. But their occurrence in the elderly person with diabetes is of such frequency that all patients with these conditions should be investigated for the disease, particularly if there is a suspicious family history.

Extraocular Muscle Palsies

It is believed by some that diabetic neuropathy may involve the third and sixth cranial nerves. The paralysis is often preceded by a period of pain which tends to follow the distribution of a branch of the trigeminal nerve on the affected side. The condition is self-limiting, and recovery is generally complete in 6 to 12 weeks.

Neurological Complications

Peripheral Neuritis

The true incidence of diabetic neuropathy is unknown in the elderly population because of the difficulty in distinguishing it from age-related involutional changes affecting peripheral sensation and the deep tendon reflexes. Clinical experience recognizes the very common occurrence of peripheral neuritis in aged diabetics, however, even though the specific etiology is not clear. Measurement of the Achilles tendon reflex in a great many patients reveals a high incidence of absent reflexes in the aged, both diabetic and nondiabetic. Here, again, the absence of deep tendon reflexes

should not be accepted as a manifestation of advanced age only, until investigation has failed to reveal an associated cause.

Neuropathic Ulcer

The painless ulcers seen at pressure points on the feet of elderly diabetics may occur in the presence of an entirely adequate blood supply. They are to be distinguished from those lesions resulting from occlusive vascular disease.

TREATMENT

Generally accepted criteria for good control of diabetes in the aged are not available. The author has used the following guidelines: (1) absence of symptoms, e.g. thirst, loss of weight, etc.; and (2) blood sugar under 200 mg. % 2 hours postprandial.

The urinary sugar may be grossly misleading. One often finds a trace or 1 plus sugar with a blood sugar of 250–300 mg.%. It is therefore desirable to depend on the postprandial blood sugar for evaluation of the effectiveness of the therapeutic regimen.

If control is inadequate by means of diet alone, oral hypoglycemic drugs should be prescribed.

If dietary restriction and oral hypoglycemic drugs are ineffective, insulin is indicated.

In cases with thirst, loss of weight and blood sugars of 250–500 mg.%, it is wise to start immediately with a restricted diet and hypoglycemic drugs.

Patients exhibiting ketosis require insulin therapy without delay.

Diet

As in all age groups, the aged diabetic should have a well-balanced diet with restricted carbohydrates, adequate protein and a moderate fat content. The total caloric intake should depend on the presence or absence of obesity. A useful schedule is as follows: 1400 calories with 140 grams of carbohydrate; 1200 calories with 100 grams of carbohydrate; 1000 calories with 80 grams of carbohydrate. Protein should be 1 to 1.5 grams per kilogram of optimum body weight. The remaining calories should be derived from fat.

It is believed that a rigid, weighed diet is neither practical nor necessary in the aged but this does not permit gross dietary indiscretions. It is important to point out that the physician must be sufficiently flexible and resourceful in his dietary recommendations to cope with the difficulties of changing a fixed food pattern in an elderly person.

A state of good dental repair is essential. Well-fitting dental plates should be provided if adequate chewing surfaces are lacking. All sources of infection in the mouth should be cleared up.

Oral Hypoglycemic Agents

If diet is unsuccessful in controlling the diabetic state, oral hypoglycemic agents should be prescribed. The type of case most likely to respond to this type of therapy is: (1) maturity onset type of diabetes; (2) diabetes or recent onset; and (3) diabetes requiring less than 40 units of insulin daily for adequate control.

The sulfonylurea derivatives exert their hypoglycemic effect by stimulation of the pancreatic beta cells to produce insulin. Phenethylbiguanide, belonging to a different class of compounds, differs in that it is effective in the absence of functioning pancreatic tissue. It increases peripheral utilization of glucose by a mechanism not clearly understood at present. The sulfonylurea derivatives (tolbutamide, chlorpropamide and acetohexamide) should not be used in patients with a history of sensitivity to sulfonamide drugs or who are suffering with liver or renal impairment. Oral drug therapy should not be used to permit dietary laxity. Strict medical supervision and proper dietary control are essential.

Oral therapy has eased the problem of the aged patient who lives alone and suffers from poor vision, parkinsonism, severe arthritis, and other infirmities. However, it must be remembered that some of the aged are forgetful and will skip doses. If questioned, they will insist that the pills have been taken, forgetting the omissions. Another psychological hazard is the difficulty of convincing the older patient that regular administration of medication is necessary. Old health patterns, particularly when they have been determined by a person who has lived many years and often has "doctored" himself, may be hard to break. He often assumes that his own judgment about medication is superior because its necessity is best dictated by how he feels.

Tolbutamide (Orinase)

The initial dose generally is 1 gram twice daily, before breakfast and supper; this is later adjusted according to the response of the patient. A maintenance dose of .5 grams twice daily will control most patients, but the range is between .5 grams and 2

grams daily. Only infrequent instances of hypoglycemia have been recorded, but it should be noted that the aged patient with induced hypoglycemia may not show the typical sweating and cool skin. The diagnosis of a cerebrovascular accident is often mistakenly made on the basis of confusing clinical signs, and it is believed that the blood sugar should be determined in any aged diabetic who presents such a picture. Incidence of liver damage is rare from use of this drug.

Chlorpropamide (*Diabinese*)

This preparation has a more prolonged action, and therefore can be used in a once-a-day dosage taken in the morning. The initial dose is 500 milligrams, which generally can be reduced to 200 to 250 milligrams per day. The range of daily maintenance dosage is 100 to 250 milligrams. Untoward reactions involving skin, liver, and gastrointestinal tract are more common than with tolbutamide. One must be on the lookout for the occurrence of hypoglycemic reactions.

Acetohexamide (*Dymelor*)

This most recently available sulfonylurea derivative exhibits the same pharmacological reactions as the others. It has not been in use long enough to delineate the range and severity of side effects.

Phenethylbiguanide (*Phenformin*)

This drug may be most useful in cases where there is secondary failure with sulfonylureas, where there is a history of sensitivity to sulfonamides, and where obesity is an especially important factor in treatment. As already noted, its mode of action is peripheral rather than on the pancreatic beta cell. It is said to lack the stimulus to lipogenesis seen with the sulfonylureas and insulin. The drug is available in slow release form in capsules containing 50 milligrams and also as 25 milligram tablets. The former is more useful. It is best to start with a 50 milligram capsule in the morning with breakfast, and if no side effects appear and control is inadequate, an additional 50 milligrams may be given with the evening meal. It is not advisable to administer more than 150 milligrams daily to the aged diabetic. Although serious toxic reactions have not yet been reported, the incidence of side effects such as anorexia and nausea is high. Reduction of dosage is effective generally in controlling these symptoms.

A patient taking oral hypoglycemic agents must be seen regularly by his physician to avoid development of difficulties. The possibility of secondary failure of the oral agents must always be kept in mind. In secondary failure, a good initial response is followed after varying intervals by lack of control without apparent cause. This is said to be negligible with the use of phenformin.

Insulin

If the patient requires insulin for proper control of his diabetes, there should be no hesitation by the physician in prescribing it. Most cases will require 20 to 30 units of an intermediate acting insulin, e.g. NPH or Lente given in the morning. Mixtures of crystalline with the intermediate types should be avoided where vision is impaired or where use of the hands is affected by arthritis or tremor.

It must be remembered that to many aged persons, a syringe and needle represents a threatening instrument. This emotional reaction, coupled with the presence of multiple physical impairments, may present formidable difficulties in proper management. But, on the other hand, stereotyping should be avoided. Not all the aged suffer from physical and emotional impairments. The number of aged people who learn the principles of self-care including the administration of insulin is much greater than is generally believed. "Old dogs" learn very well indeed—if they are taught properly. Patience and understanding on the part of the physician is necessary to help his patient overcome these difficulties. However, he is often too busy to find the time to give the necessary instructions. In many communities there are agencies such as the Visiting Nurse Association which can provide skilled instructors who, after teaching the proper techniques, can also periodically check to see whether the patient is following instructions. The physician, therefore, is obliged to acquaint himself with those available community resources, the functions of which are to aid him in rendering medical care in its most comprehensive sense.

During the administration of insulin, the avoidance of hypoglycemia is of the greatest importance in aged diabetics who may be suffering from coronary and cerebral vascular insufficiency. The occurrence of coronary occlusion following hypoglycemia is a very real danger in the aged. Also, since an adequate supply of glucose to the brain is essential, a marked decrease in that which is available can be catastrophic, especially when the blood supply is already compromised.

Drug Interactions

Certain drugs administered along with the oral hy-

poglycemic agents may potentiate their action and produce a hypoglycemic reaction. Coumarin anticoagulants, phenylbutazone, propranolol (inderal), and sulfonamides may enhance the effect of the sulfonylureas.

The action of alcohol and the barbiturates may be increased when administered to patients under sulfonylurea treatment.

Thiazides may reduce glucose tolerance.

Propranolol may potentiate the response to insulin.

General Suggestions for Management

Meticulous attention to foot care, skin infections, and pruritis vulvae is essential.

Treatment of the various complications of diabetes requires no special consideration in this discussion.

The incidence of diabetic coma in the aged is low. In a report of several series, totaling 969 instances of coma in 719 patients, the average age ranged from 27.9 to 31.1 years. Should coma intervene, it is managed in the usual way with special precautions because of the fragile cardiac and renal balance often seen in old people. The following considerations deserve mention:

1. Blood sugar levels rather than glycosuria should be used as guideposts for management.

2. There must be careful watch constantly for cardiac complications during administration of saline, and also careful monitoring of the volume of fluid administered in a 24-hour period.

3. Wide swings of blood sugar with hypoglycemia must be especially avoided.

4. Careful monitoring of serum potassium must be carried out, particularly if coronary artery disease is present or if the patient is receiving digitalis.

The carrying of some sort of identification has particular merit in the aged diabetic in whom abnormal behavior due to hypoglycemia or ketosis may be attributed to such conditions as senility and small strokes.

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GOUT IN THE OLDER PATIENT

By

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INTRODUCTION

The incidence of gout in the general population is unknown. The condition is probably due to a single dominant gene which is responsible for the transmission of asymptomatic hyperuricemia. In one collection of well-documented cases, 75 percent showed a familial incidence and an elevated serum uric acid was found to be very common in asymptomatic relatives. The vast majority of cases (95 percent) occur in males, but after the age of 50 the incidence in females increases. The age of onset is between the second and seventh decades, though the greatest number occur in the fourth and fifth decades. It is no longer thought that gout is a disease of the wealthy and to be due to excessive drinking and eating. No racial factors have been identified.

PATHOGENESIS

Uric acid is formed from purines which are derived from the nuclear proteins of endogenous and exogenous sources. The "miscible pool", i.e., the total amount of uric acid in the body, is relatively constant and depends on the rates of input and output. The input depends on the breakdown of endogenous and exogenous nuclear proteins. The output is chiefly by way of renal excretion. Uric acid is a threshold substance which is reabsorbed in the renal tubules. The urate clearance increases as plasma urates increase.

Renal clearance of urate is decreased by a variety of factors which include: a ketogenic diet, a high fat diet, starvation, exercise, elevated blood lactate, the administration of chlorothiazides and small doses (1 to 3 grams) of salicylates. Increased urate clearance, probably due to blocking of renal tubular reabsorption, is produced by probenecid (Benemid), large doses of salicylates (5 to 6 grams), ACTH and adrenal corticosteroids of the 11–17 oxysteroid type. Colchicine has no effect on uric acid excretion.

In most cases of primary gout, there is an increased production of uric acid and an increase in its urinary excretion in the absence of renal disease. In a small number of cases, the basic defect is an inability to excrete adequately plasma urates, even when it is at a normal level. This is presumably due to tubular dysfunction.

The secondary gouts are not genetic. The increased nuclear protein breakdown in hematological diseases such as polycythemia, hemolytic anemia, myeloid metaplasia, pernicious anemia, leukemia and malignant lymphoma produce an increased urate production. These conditions rarely cause clinical gout in its classic picture. Renal disease with decreased glomerular filtration is a very common cause of hyperuricemia, although only very rarely, if ever, is it a cause of clinical gout.

Substances like the chlorothiazides, by competitive inhibition, prevent tubular transport of urates, thereby elevating blood uric acid, and may produce an attack of gouty arthritis in a susceptible individual. Low dosages of salicylates produce elevated levels of uric acid which may confuse the diagnosis.

Apparently acute gouty arthritis is due to the physical characteristics, rather than the chemical action of urates in the joints. Experimental injection of amorphous sodium urate produces little or no inflammation in the joint, whereas similar use of crystalline urates results in a clinical attack of gout. Punch biopsies have also revealed the presence of needle-like crystals. Recently the entity of "pseudogout" has been described and found to be caused by pyrophosphate crystals rather than urate.

CLINICAL PICTURE

The typical picture of acute gouty arthritis begins with arthralgia of increasing intensity, reaching a maximum degree within 12 to 24 hours. In about 50 percent of cases the first metatarsophalangeal joint is involved. Other joints in the foot, knee, wrist and elbow may be affected. The joint is extremely painful, exquisitely tender and swollen, and the overlying skin is pinkish-blue in color, often extending beyond the limits of the joint and sometimes superficially resembling a cellulitis. Pyrexia with leucocytosis and elevated sedimentation rate accompany the malaise.

Characteristically, the patient is completely asymptomatic between attacks but as the disease progresses, the symptom-free periods become progressively

shorter. Factors such as trauma, surgery, exposure to cold, injections of foreign protein, epinephrine, liver extract and emotional stress may trigger an attack.

The patient with chronic gout is recognized by the presence of deformed joints and/or tophi and a history of recurrent attacks of joint pain. The presenting chronic picture may relate entirely to the kidney which, due to infiltration with urates, presents the picture of nephritis.

DIAGNOSIS

The prompt diagnosis of gout is important because it is the only type of arthritis which is easily managed and in which progression can almost certainly be halted.

Acute Gout

The presence of hyperuricemia is usually essential for a diagnosis of gout. There are several methods for the determination of blood uric acid with slightly different ranges of normal, but cases of untreated primary gout generally show levels of 8–12 mgs. per 100 ml. of blood. In cases of complicating renal disease, the values may be higher. One must keep in mind the other causes of hyperuricemia such as ketogenic diet, chlorothiazides, hypoparathyroidism, and small doses of salicylates. These factors are of additional importance in the older age groups, particularly chlorothiazides, because of the frequency of their use in cardiac disease.

Examination of the joint by aspiration punch biopsy of the synovial tissue is rarely, if ever necessary, in the clinical management of an aged patient with gout.

A therapeutic test with colchicine is of prime importance. In general its specificity is such that if there is no response, the diagnosis must be questioned.

Chronic Gout

In this condition, X-ray examination reveals typical destruction in the joints with "punched out" areas due to replacement of bone by radiolucent tophaceous material. Tophi are also commonly seen about the ears, tendons, and the olecranon and patellar bursae. Aspiration reveals a chalky material which consists of sodium urate.

Pseudogout

Recently the syndrome of pseudogout, mimicking primary gout, has been described in elderly people. It is characterized by recurring attacks of synovitis of the large joints. Like gout, it is caused by the presence of crystals in the joints, but in this case the material is calcium pyrophosphate dehydrate. In these patients, colchicine administration serves both as a diagnostic and therapeutic maneuver. If a patient presents himself with the clinical picture of gout, but fails to show hyperuricemia and at the same time responds to colchicine, the diagnosis of pseudogout is very likely. The presence of the typical crystals in an aspirate of the joint will confirm the diagnosis.

Differential Diagnosis

Acute gouty arthritis in the elderly may be confused with rheumatoid arthritis, osteoarthritis, acute cellulitis, bursitis, thrombophlebitis and traumatic arthritis. A high index of suspicion should direct the physician's attention to the possibility of gout, and a determination of the blood uric acid will confirm the diagnosis. The attack following any of the triggering conditions, such as surgery or following minor injury to the joint, should even more strongly bring the possibility of gout to the fore.

Laboratory Characteristics of Various Gout Producing Symptoms (Sorensen, 1963)

	Plasma urate	Urinary urate	Blood urea nitrogen	Creatinine or urea clearance
Primary gout	Increased	Increased	Normal or slightly increased.	Unchanged.
Hematological disorders	do	do	Unchanged	Do.
Renal disease	do	Decreased	Increased	Do.
Chlorothiazides	do	Unchanged or slightly decreased.	Unchanged	Unchanged.

TREATMENT

Once a patient has experienced an attack of acute gouty arthritis, he should be placed on a therapeutic regimen for the rest of his life. This is particularly important in the aged who are very likely to have decreased renal function and other complicating conditions as osteoarthritis, diabetes, etc.

The aims of therapy are :(1) to terminate the acute episode; (2) to decrease the hyperuricemia and thereby prevent repeated attacks; and (3) to reduce the urate infiltration if present. Thus it is that in the great majority of cases the treatment is both curative of the individual attack and preventative.

Relief From Acute Arthritis

In the presence of an attack of acute arthritis, the patient should be put to bed and the affected joint put at complete rest. Often a support to keep the bed covers off the joint will be required because of the exquisite tenderness. However, motion of the joint should be permitted as soon as it can be tolerated.

Colchicine is the medication of choice. Its mechanism of action is unknown but it is not uricosuric. This drug is so specific that if an adequate dose fails to terminate an attack, the diagnosis of gout must be seriously questioned. The customary dosage is 0.5 mgms. (1 tablet) at hourly intervals until pain is relieved or diarrhea ensues. Relief generally occurs in 10 to 12 hours. As a rule, no more than 6 mgms. should be administered in 1 course of treatment. If pain reappears, 48 hours should be permitted to elapse before another full course of therapy is instituted. Some physicians prefer starting with 1 mgm. (2 tablets) as an initial dose. Generally, the earlier that therapy is started, the less the total amount of drug is required to control the pain. Colchicine may be given intravenously, but the high incidence of phlebitis at the site of the injection may be serious, particularly in aged patients.

Phenylbutazone (*Butazolidin*) may be a very effective analgesic but should not be given for more than 3 days because of the hazard of bone marrow depression. An adequate dosage scheme is 100 mgms. every 6 hours around the clock. Tenderil, an analog of phenylbutazone, offers no decisive advantages over the parent compound.

Salicylates are sometimes used in an acute attack. Although large doses of acetylsalicylic acid (2 to 5 grams daily) or sodium salicylate are analgesic and moderately uricosuric, they are rarely as effective as colchicine.

Corticosteroids and ACTH are effective but have the disadvantage that they must be accompanied by colchicine during and following the cessation of therapy to avoid the recurrence of symptoms. In aged people, the large doses required may be deleterious in view of the possibility of heart and renal disease.

During the acute arthritic attack, the ingestion of fluids should be encouraged to handle the increased uric acid excretion. Diet should be low in fat and purine content. The former decreases urinary excretion of uric acid and the latter increases its production.

Prevention of Attacks by Uricosuric Agents

Probenecid (*Benemid*) is a very effective uricosuric agent. The initial dose is 0.5 grams daily and is increased gradually until adequate response is obtained. This is gauged by the changes in the level of blood urate. The average maintenance dose is 1 to 1.5 grams daily. In tophaceous gout, higher doses may be required. As a matter of fact, the blood levels may not be decreased even in adequately treated cases of tophaceous gout, while urate is being mobilized from the tophi. But effective dosage can be determined by observing the increase in its urinary excretion.

Sulfinpyrazone (*Anturane*) is also an effective uricosuric agent. The initial dose is 200 mgms. daily and is increased gradually to 400 mgms. All considerations which apply to probenecid apply equally to this drug.

In the use of a uricosuric agent, the inhibiting influence of small amounts of salicylates on effective action of these drugs must be kept in mind. This is particularly true when dealing with older people, many of whom take small quantities of salicylates regularly. They should be warned against it.

If the initiation of uricosuric therapy is attended by the onset of an acute attack, as may occur in a small number of patients, colchicine may be given concurrently in doses of 0.5 mgms. twice daily.

Fluid intake should be sufficient to maintain a urinary output of 1500 to 2000 ml. daily, and the urine should be made alkaline to a pH of 7.0 to 7.5 to avoid precipitation of urates in the kidneys or ureters. The aged patient will find the following alkalinizing mixture preferable to the large doses of bicarbonate that are usually required: citric acid 40 grams, sodium citrate 60 grams, potassium citrate 66 grams, extract aurantii 6 grams, syrup simplex ad 600 cc. The dose is 60 c.c. daily. Many patients find that chilling the mix-

ture makes it even more acceptable. The possibility of producing a metabolic alkalosis in aged patients with impaired renal function must always be kept in mind.

Diet

There is no need to severely restrict the diet with respect to purine content in the average patient with gout who is receiving uricosuric agents. But high-purine foods such as liver, kidney, anchovies, sardines, sweetbreads, and meat extracts should be avoided. The fat content should be low because fat decreases uric acid excretion and also it is desirable to prevent obesity in the aged. If the fat content is to be kept low, the carbohydrate content must of necessity be increased. This should not, however, be sufficient to permit an excessive gain of weight. As has been pointed out, gout occurs primarily in individuals over 50 years of age, many of whom are obese and have familial histories of diabetes, so that one must watch for these complications. Although it is desirable to advise the obese individual to lose weight, it must be remembered that uric acid production may be increased during very rapid weight loss. This must be countered with colchicine therapy in addition to benemid when necessary. Consumption of tea and coffee need not be restricted since they make no contribution to uric acid production as has been thought in the past.

Chronic Gout

During the course of chronic gout, those acute attacks which occur intermittently are treated as already described. Since mild to moderate symptoms often persist, it is wise to administer colchicine and benemid simultaneously. Colchicine is perfectly safe to administer if there is no liver damage and the carbohydrate content of the diet is adequate.

As has already been pointed out, the level of blood urate often remains elevated in tophaceous gout despite adequate uricosuric treatment. Under these conditions, an increase in urinary excretion indicates removal of urate from the tissues.

Renal impairment in gouty renal disease may be expected to improve if treated vigorously in the early stages.

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APPLICATION OF FLUID AND ELECTROLYTE BALANCE PRINCIPLES TO THE OLDER PATIENT

By

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INTRODUCTION

The ability to maintain, within narrow limits, fluid volumes and electrolyte concentrations in the various body compartments is necessary for survival. Older persons retain a remarkable capacity to maintain the chemical and physical composition of the body fluids within a narrow normal range under basal conditions. However, they do require a longer period of time to return abnormal blood levels to the normal range when deficits or excesses are imposed by disease or environmental stresses.

The capacity of any individual to return fluid and electrolyte composition to the normal range diminishes proportionately with a decrease in renal function. Since the average 80-year-old person has approximately one-half the renal function (glomerular filtration rate) of that of the normal 30-year-old person, it takes him approximately twice as long to correct any induced fluid or electrolyte abnormality.

NORMAL VARIATIONS IN BODY FLUID AND ELECTROLYTES

Total Body Water, Extracellular Fluid and Intracellular Fluid

The total body water content diminishes significantly with age (Shock, 1961). Extracellular fluid volume, however, tends to remain remarkably constant with age, and therefore constitutes a larger percentage of total body water in the older person. The reduction in total body water then is a reflection of decreased intracellular water presumably due to tissue loss with age. Further confirmation of an age-related decrease in lean protoplasmic mass is obtained if one studies total body potassium or exchangeable potassium in young vs. old subjects.

Blood, Plasma and Red Cell Volumes; Plasma Proteins

Although the range of individual variation in plasma, blood and red-cell volume is large, it appears that these values remain essentially unchanged with age (Shock, 1961). The total plasma proteins, which play an important role in regulating the osmotic pressure of the blood and in maintaining blood volume, also remain unaltered with age (Shock, 1961; Elkinton and Danowski, 1955). Serum albumin levels, however, do appear to decrease slightly with age and serum globulin levels tend to increase.

Serum Electrolyte Concentrations

Sodium, potassium, chloride and bicarbonate levels are not significantly altered with age under basal conditions (Shock, 1961; Elkinton and Danowski, 1955). Blood pH, bicarbonate and pCO_2 values also fail to show significant changes with age (Shock and Yiengst, 1950). When challenged with an acid load, however, older persons do take longer to return serum bicarbonate levels to basal levels. The interval necessary to correct an imposed acidosis is inversely proportionate to the level of residual renal function (Adler et al., 1968).

DEHYDRATION AND OVERHYDRATION

Dehydration

The level of fluid intake required to maintain fluid and electrolyte balance varies significantly with the individual and with his environment. The minimum intake of water necessary to prevent dehydration is that amount required to replace losses through the lung, skin, gastrointestinal tract and kidneys. In persons with free access to water, the thirst mechanism is adequate to insure sufficient intake of fluids for maintenance of normal body fluid levels. Only small amounts of sodium chloride are needed daily to replace losses and maintain balance. Unless dietary sodium intake is severely restricted or there are abnormal gastrointestinal or renal losses of salt, salt depletion does not occur. Although extracellular fluid volume depletion may occur from inadequate replacement of water losses (simple dehydration), it more commonly results from a loss of sodium with its osmotically obligated water (primary salt depletion). An increase in serum sodium concentrations and osmolality is seen in the former; serum sodium levels and osmolalities are normal or decreased in the latter.

Simple Dehydration

Deficits of body water occur in their least complicated form in patients who for some reason do not receive or retain an adequate supply of water. In persons with free access to water, the thirst mechanism is adequate to insure sufficient intake of fluids for maintenance of normal body fluid volumes. Simple dehydration may result from inadequate intake of fluids in neglected or unconscious persons, persons with cerebrovascular accidents or other central nervous system disease, persons with obstructive lesions of the upper gastrointestinal tract, or mental patients who refuse fluids. A few patients with neurological disease have impaired thirst mechanisms which may make them susceptible to dehydration. Surgical intervention in patients with aneurysms of the Circle of Willis may result in damage to the thirst center. Such individuals, unless required to ingest a required quantity of fluids daily, are prone to develop progressive dehydration and hypernatremia. Stroke patients fed high protein formula diets by nasogastric feeding tubes without adequate water also may develop simple dehydration. The increased solute load increases losses of fluid in the stool and urine.

Simple dehydration may result from abnormal losses of water from the gastrointestinal tract or kidneys. Most patients with large gastrointestinal losses due to diarrhea, vomiting or fistula drainage also become electrolyte depleted. Renal losses of water are most marked in patients with diabetes insipidus, but simple loss of concentrating ability also may contribute to development of dehydration. Patients with hypercalcemia, hypokalemia or advanced renal disease fall in this category. Patients with increased urinary solute, most notably the individuals with uncontrolled diabetes mellitus, lose water in excess of sodium and other electrolytes.

Pituitary diabetes insipidus in the older age groups is most often due to an intracranial neoplasm, either primary or metastatic; but traumatic, postoperative, infectious, granulomatous and vascular origins must be considered. Although one-third of all cases of diabetes insipidus are idiopathic, these cases usually have become manifest at an early age. Nephrogenic diabetes insipidus is a rare disease in the older age groups, but may occur as an acquired lesion due to potassium deficiency, amyloidosis or partial ureteral obstruction.

Thirst is the earliest symptom of water loss. In patients with impaired thirst, desiccation may be manifested as fever, flushing, loss of sweating and dryness of the tongue and mucous membranes. A tachycardia develops and personality changes occur. With severe dehydration, hallucinations, delerium, manic behavior, convulsions and coma may develop.

Treatment is aimed at replacing water deficits. Water can be given orally, or 5 percent dextrose and water can be given parenterally. In susceptible individuals, preventive precautions need to be considered.

Primary Salt Depletion

Patients with primary salt depletion syndromes maintain normal serum sodium concentrations and osmolalities until volume depletion becomes sufficient to stimulate antidiuretic hormone (ADH) release. At this time, water retention develops and hyponatremia begins to occur. Salt depletion with hyponatremia and decreased extracellular volume is discussed in more detail in the section on hyponatremia.

Overhydration

The excessive retention of body fluids may result from primary salt retention with its osmotically obligated water (simple edema), or from retention of water in excess of salt (primary water intoxication, dilutional hyponatremia or inappropriate ADH levels). Individuals with primary salt retention and edema eventually retain water in excess of salt and become hyponatremic.

Simple Edema

Salt retained with its osmotically obligated water leads to edema formation with normal serum sodium concentrations and osmolalities. This occurs with increasing frequency in older persons and can usually be attributed to congestive heart failure, cirrhosis, the nephrotic syndrome or renal insufficiency. In these patients, treatment is aimed at the underlying disease, at reducing sodium intake and increasing urinary salt excretion with diuretic therapy.

Primary Water Intoxication, Dilutional Hyponatremia and Inappropriate ADH Syndrome

These entities are discussed under the section on hyponatremia.

HYPONATREMIA AND HYPERNATREMIA

Hyponatremia

The plasma sodium concentration alone fails to reflect whether there is an excess or deficit of total body sodium. The total body sodium can only be estimated

if extracellular fluid volume also is known. A low serum sodium concentration may result from: (1) a loss of sodium in excess of osmotically obligated water; (2) a retention of water in excess of sodium; or (3) a combination of both.

In considering the conditions in which hyponatremia may be encountered in elderly persons, it is best to divide them into three general categories, i.e., one with extracellular volume depletion, one with extracellular volume expansion, and one with normal extracellular fluid volume. Even though this distinction is made for the purposes of this discussion, such a division may be difficult to make clinically.

Hyponatremia With Decreased Extracellular Fluid Volume (ECFV)

Hyponatremia with decreased ECFV almost always results from loss of body fluids with high sodium concentration and replacement with relatively electrolyte-free solutions. Such patients invariably show a depletion of total body sodium. Low serum sodium concentrations result from an inability to excrete water due to increased levels of circulating antidiuretic hormone released in response to volume depletion. The fall in extracellular fluid osmolality initiates a shift of water into cells with evidence of intracellular overhydration (pressure over the sternum leaves a clear fingerprint) and perpetuation of extracellular fluid volume depletion.

Restricted salt intake alone in otherwise healthy persons rarely causes salt depletion. Young persons on restricted salt intakes are capable of lowering urinary sodium to levels of 2 mEq/L. Older persons, especially those with any element of parenchymal renal disease or hypertension, are unable to conserve sodium as well, so that during periods of marked restriction, they may become salt depleted. Profuse sweating rarely contributes significantly to the development of hyponatremia, as sweat sodium concentration decreases in salt-depleted individuals. Vomitus, diarrheal stools and drainage from gastrointestinal fistulas may be the source of large losses of electrolytes.

If signs of salt depletion occur with persistence of excessive urinary sodium losses, not induced by diuretic therapy, the differential diagnosis lies between adrenal insufficiency and renal disease (salt-losing nephritis or renal tubular acidosis). The former is best excluded by quantifying plasma cortisol levels or 24-hour urinary 17-hydroxy-corticosteroid excretions. If baseline excretions are low, 25 units of ACTH is infused over an 8-hour period on 3 successive days, and 24-hour 17-hydroxy-corticosteroid excretions are repeated. Small amounts of dexamethasone should be given prior to the ACTH to prevent untoward reactions to the infusion. Renal tubular acidosis is suspected if urine pH exceeds 6.0 in the presence of an acidosis (serum bicarbonate 20 mM/L). Salt-losing nephritis may be seen in patients with evidence of chronic pyelonephritis, hypertension, polycystic kidney disease, and rarely in chronic glomerulonephritis.

Patients with salt depletion complain of muscle weakness, apathy and lassitude. Headache, postural lightheadedness and muscle cramps also may develop. As sodium loss becomes more marked, mental confusion, delirium, delusions, stupor and coma may develop. Thirst usually is not a significant complaint. Skin turgor and elasticity decrease so that forearm skin remains folded when picked up. One must be careful in interpreting this finding in elderly or cachectic patients as this may occur without sodium depletion. Orthostatic hypotension and tachycardia occur early; clinical shock occurs later.

Hyponatremia With Increased Extracellular Fluid Volume

The differential diagnosis is as follows:

1. Dilutional hyponatremia
   - A. Congestive heart failure
   - B. Cirrhosis
   - C. Nephrotic syndrome
   - D. Renal failure
2. Inappropriate ADH syndrome
   - A. Pulmonary neoplasms and disease
   - B. Cerebral disease
   - C. Miscellaneous (porphyria, myxedema, idiopathic)
3. Postoperative state
4. Primary water intoxication

Impairment in water excretion occurs commonly in situations where urinary salt excretion also is severely impaired. Patients with heart, liver or renal failure and gross edema are severely limited in their ability to excrete both salt and water in the urine. The universal practice of sharply restricting salt intake but placing no limitations on fluid intake in edematous patients is probably appropriate in most patients. However, once hyponatremia begins to develop, it may be necessary to also restrict water.

A syndrome of inappropriate ADH secretion is seen in patients with pulmonary neoplasms, most notably

oat cell carcinomas, other pulmonary disease, and in a variety of cerebral disorders including trauma, cerebrovascular accidents, encephalitis, subarachnoid hemorrhage and tumor. It has been described in patients with other tumors, porphyria, myxedema, and following the use of diuretic agents. A persistent high level of circulating ADH is considered inappropriate when neither hyperosmolality of the serum nor volume depletion, the usual stimuli to ADH release, is present. Inability to excrete water leads to volume expansion, which, by multiple renal mechanisms, leads to increased urinary salt loss. Although initially these patients have a dilutional hyponatremia, a component of depletion of total body salt may eventually develop due to this increased urinary salt loss.

The problem frequently arises in the non-edematous patient of differentiating salt depletion hyponatremia from the syndrome of inappropriate ADH. Unless the salt depletion is a result of excessive loss of salt through the gastrointestinal tract, in both conditions any amount of urinary sodium loss from normal to increased levels may occur. Urine osmolalities will be in the hypertonic range despite hypotonic plasma levels. In the salt-depletion state, volume depletion appropriately stimulates increased ADH levels; in the inappropriate ADH syndrome, the increased ADH levels are unexplained. Generally blood urea nitrogen levels are normal to elevated in salt depletion, but normal to low normal in the inappropriate ADH syndrome. A blood volume determination and central venous pressure monitor will aid in forming an opinion about the nature of the underlying disorder. If the blood volume is low to normal and the central venous pressure is less than 4 cm, isotonic saline (or hypertonic saline if serum sodium is below 120 mEq/L) can be infused slowly while following the central venous pressure until it shows evidence of an increase (to levels of 10 cm).

Postoperative patients may excrete hypertonic urine even when adequately hydrated due to continued secretion of ADH. There is a serious tendency to underestimate salt losses and overestimate fluid needs in the postoperative patient, so that hyponatremia is frequently observed in the postoperative period.

When the posterior pituitary gland, the kidneys and the adrenal glands are functioning normally, it is almost impossible for a person to ingest enough water to produce water intoxication. For unexplained reasons, one exception appears to be the schizophrenic patient.

Overhydration with hyponatremia—whether it be due to dilutional hyponatremia, the inappropriate ADH syndrome or primary water intoxication—is characterized by symptoms of strange behavior, confusion, delirium and muscle weakness progressing to convulsive seizures and coma presumably resulting from cerebral edema. Treatment is restriction of fluid intake and, if it appears total body salt is increased, restriction of salt and enhancement of salt loss with appropriate diuretics. If overhydration becomes life-threatening, peritoneal or hemodialysis may be necessary.

Hyponatremia With Normal ECFV

Asymptomatic hyponatremia is an interesting finding in patients with chronic pulmonary disease (Sims et al., 1950). A similar finding is seen in many elderly patients with chronic illnesses such as arteriosclerosis and malnutrition. It is distinguished from true salt depletion or water intoxication by its chronicity and lack of symptoms. Neither administration of salt nor water restriction corrects the hypotonic state. A common explanation for this syndrome in the past has been that these persons develop an intracellular hypo-osmolality due to the leak of potassium and other solute out of the cell ("sick-cell syndrome"). This presumably leads to a shift of water out of the cell along the osmotic gradient and an increase in ECFV. Solute and water are lost in the urine until a new equilibrium state is established. More recent studies suggest that these patients might belong in the spectrum of patients with inappropriate ADH syndrome (Weiss and Katz, 1965). Regardless of the pathogenesis, such patients generally do not develop severe hyponatremia and no therapy for the hyponatremia is indicated.

Artefactual hyponatremia develops in patients with marked hyperglycemia and hyperlipemia. Glucose increases osmolality in the ECFV, drawing water from inside the cell and diluting the sodium concentration in the extracellular fluid. Water insoluble lipids displace serum water, yet do not contain sodium; as a consequence, sodium analyses show inappropriately low values.

Hypernatremia

Hypernatremia usually occurs only in persons who, because of inability to communicate, are unable to obtain sufficient water to replace losses. These patients develop the simple dehydration previously described. Hypernatremia resulting from ingestion of large, hypertonic quantities of sodium chloride or bicarbonate is unusual and easily recognized.

HYPOKALEMIA AND HYPERKALEMIA

Potassium is primarily an intracellular cation; only a small portion of the total body potassium is contained in the extracellular fluid compartment. Therefore, the serum concentration of potassium may fail to reflect accurately total body potassium stores. A potassium flux into cells occurs with cell growth, with intracellular nitrogen and glycogen deposition, and with increases in extracellular pH; potassium leaves the cells with cell destruction, glucose utilization and decreases in extracellular pH. In interpreting the significance of a particular serum potassium concentration, consideration must be given to these factors affecting the ratio of intracellular to extracellular concentrations. A dramatic example is provided by the patient with diabetic acidosis who, prior to treatment, has high serum potassium levels, but with correction of the acidosis and treatment of the hyperglycemia shows a dramatic decrease in plasma potassium as intracellular potassium is replenished.

Hypokalemia

The most striking symptom of hypokalemia is muscle weakness, but muscle tenderness, apathy, abdominal distention and even paralytic ileus may develop. Polyuria due to inability to form concentrated urine and metabolic alkalosis also are commonly seen. Characteristic electrocardiographic changes are observed, including T wave changes, a lengthening of the Q-T interval and various arrythmias. Hypokalemia also enhances the effect of cardiac glycosides and induces toxicity with usual maintenance doses of the drug.

The following may contribute to the development of hypokalemia:

1. Inadequate potassium intake
2. Metabolic alkalosis
3. Excessive gastrointestinal losses
   - A. Diarrhea
   - B. Fistulous drainage
   - C. Vomiting
4. Excessive urinary losses
   - A. Adrenal disease
     - (1) Hyperaldosteronism, primary
     - (2) Cushing's disease
   - B. Renal disease (secondary hyperaldosteronism)
     - (1) Renal tubular acidosis
     - (2) Sodium and postassium-losing nephritis (pyelonephritis)
     - (3) Renal artery stenosis
   - C. Diuretic therapy
   - D. Osmotic diuresis

Although the kidney is not as capable of conserving potassium as sodium during periods of reduced intake, several weeks of marked restriction are necessary to induce significant potassium depletion unless abnormal losses also are present. When salt and volume depletion occur concurrently and circulating aldosterone levels are increased, urinary potassium losses are greatly accentuated. The differential diagnostic workup, once one eliminates inadequate intake and an excessive gastrointestinal loss, is aimed at explaining excessive urinary loss. Provided that no excess solute such as glucose is found in the urine and there is no history of recent diuretic therapy, hypokalemia can usually be explained on an adrenal or renal basis. Most of the potassium in the final urine is derived from potassium secreted in the distal tubule in exchange for reabsorbed sodium. The amount of potassium (and hydrogen ion) secreted in the distal nephron is dependent upon 3 variables: (1) the quantity of sodium delivered to the distal nephron; (2) the relative amounts of potassium and hydrogen ion available for exchange; and (3) the levels of circulating aldosterone and other corticosteroids.

Elevated urinary aldosterone levels in patients with hypertension and hypokalemia may be due to either primary hyperaldosteronism or the secondary hyperaldosteronism of renal artery stenosis. Plasma renin levels will be markedly decreased in the former and elevated in the latter. Attempts to document a renal artery stenosis utilizing a rapid sequence IVP and renogram followed, if indicated, by aortography and split renal function studies, may also be indicated. Hypokalemia resulting from secondary hyperaldosteronism may also be seen in patients with renal tubular acidosis and salt-losing nephritis with volume depletion, cirrhosis and congestive heart failure.

Successful management of potassium depletion is dependent not only upon replacement of potassium losses, but also upon recognition and correction of the underlying disorder. It must be emphasized that the serum potassium level may correlate poorly with total body potassium stores. When the serum potassium level is below 3 mEq. per liter, it may take from 200 to 400 milliequivalents of potassium to increase the serum potassium 1 mEq. per liter. Since the hypokalemia is

generally associated with a metabolic alkalosis, correction of the hypokalemia is much more efficient when potassium chloride is administered than when other potassium salts are used. In acute situations where hypokalemia is marked, replacement may be achieved by placing 40 to 80 mEq. of potassium in each liter of intravenous fluid and infusing it slowly. On the other hand, it must be remembered that acute hyperkalemia can be lethal; potassium replacement should generally be accomplished over a period of days. Intravenous potassium must be used with particular caution when renal function is impaired and urine output is low. In most instances, replacement can be accomplished via the oral route.

Hyperkalemia

Clinical manifestations of hyperkalemia appear at variable serum levels presumably because toxicity depends more upon the ratio of extracellular to intracellular concentrations than the absolute serum potassium level. The clinical manifestations are subtle and appear late, often only shortly before death from cardiac arrythmias. Anxiety, extreme restlessness, apprehension, stupor, weakness and hyporeflexia should alert one to the possible existence of this imbalance. Characteristic electrocardiographic changes, initially peaking of T waves and later loss of P waves and widening of the QRS complex, also may be present.

Significant hyperkalemia is seen primarily in patients with renal insufficiency, but such factors as acidosis, increased tissue catabolism, gastrointestinal bleeding and administration of potassium supplements with diuretic therapy may precipitate hyperkalemia in otherwise stable patients. If renal function is adequate, excess potassium is readily excreted by the kidneys.

Treatment initially is aimed at lowering serum potassium by moving it into cells or by antagonizing its physiological effects with sodium or calcium salts. The first can be accomplished by infusions of hypertonic glucose, insulin and sodium bicarbonate. About 1 unit of insulin should be given for every 3–4 grams of glucose infused, e.g., 10–15 units of regular insulin should be placed in each 500 ml. bottle of 10 percent dextrose and water. Up to 100 mEq. of sodium bicarbonate can be added to each liter of dextrose and water. Calcium has an antagonistic action to potassium on the myocardium. When serum calcium levels are low, administration of 2 grams of a 10 percent solution of calcium gluconate or some other calcium salt up to 4 times daily until calcium levels reach normal, is indicated. It must be noted that calcium and bicarbonate cannot be added to the same infusion as a precipitate will form.

These measures provide only temporary depression of serum potassium levels and it must be remembered that once therapy is discontinued, serum potassium levels return to pretreatment levels. Permanent decreases in serum potassium levels are achieved with the sodium cycle sulfonic polystyrene exchange resins (Kayexalate) given orally (20 grams 2 to 4 times daily) or rectally (60 grams in 200 cc dextrose and water up to 4 times daily). Sorbitol can be given to facilitate passage of the resin through the gastrointestinal tract in a dosage of 10 to 20 cc of a 50 to 70 percent solution every 2 to 4 hours until an osmotic diarrhea is established. These exchange resins, if properly employed, are so effective that it is rarely necessary to go to peritoneal or hemodialysis to lower serum potassium levels. The exchange resins should be started whenever serum potassium levels exceed 5.5 meg/L.

ACIDOSIS AND ALKALOSIS

The body jealously guards pH and maintains it within a narrow normal range. Only small changes in pH (6.9 to 7.7) remain compatible with life. Generally an acidosis is better tolerated than an alkalosis. Fundamentally, an acidosis results from introduction of an excess of acid into the body fluids whereas an alkalosis develops from excessive loss of acid. The body must cope with 2 types of acids:

(1) *The volatile acid, CO_2.* The lungs remove the volatile CO_2 generated during metabolism. Retention of CO_2 results in an acidosis; excessive loss of CO_2 results in an alkalosis.

(2) *Fixed hydrogen ion.* The hydrogen ion and its associated organic (lactate, pyruvate, acetoacetate, B-hydroxybutyrate, etc.) and inorganic (phosphate, sulfate, chloride) anions are buffered in body fluids and can be excreted only by the kidney or in other fluids such as those lost via the gastrointestinal tract.

In dealing with any shift in acid-base balance, 4 mechanisms for handling these acids must be considered:

(1) *Extracellular buffer systems.* A change in pH affects all buffer systems in the blood simultaneously. A study of the CO_2-bicarbonate buffer system has the advantages that it can be easily and accurately quanti-

fied and it is the only buffer system directly affected by respiration.

(2) *Intracellular buffer systems.* Equilibration between the intracellular and extracellular buffers following any acute shift in acid-base balance occurs over a 2 to 4-hour period. The total buffering capacity of the 2 compartments is about equal. The fluid volume of the intracellular compartment is twice as large as the extracellular compartment. This means that the concentration of buffers is only half as great in the intracellular compartment.

(3) *Respiratory compensation.* Temporary compensatory changes in pH can rapidly be accomplished (over a 10 to 30-minute period) by altering respiratory rate and the level of retention of the volatile acid CO_2.

(4) *Renal disposal of excess fixed acids and bases.* Ultimate disposal of fixed acids and bases to restore body fluids to their normal state and prevent accumulation of neutralized products must be accomplished by the kidney; this may require hours to days.

Alterations in acid-base balance are generally described in terms of changes in the CO_2-bicarbonate system, as these changes mirror shifts in all other buffer systems in the blood and tissues. Easily quantified are the blood pH, total CO_2 content or bicarbonate and pCO_2. A number of nomograms have been developed to show the interrelationships between these 3 parameters. Although measurement of 2 of these parameters will allow one to calculate the third using the Henderson-Hasselbalch equation, measurement of all three provides a check on one's analytical procedures.

Figure 1 illustrates one technique for visualizing acid-base disturbances plotting pH on the horizontal axis and total CO_2 content on the vertical axis. The

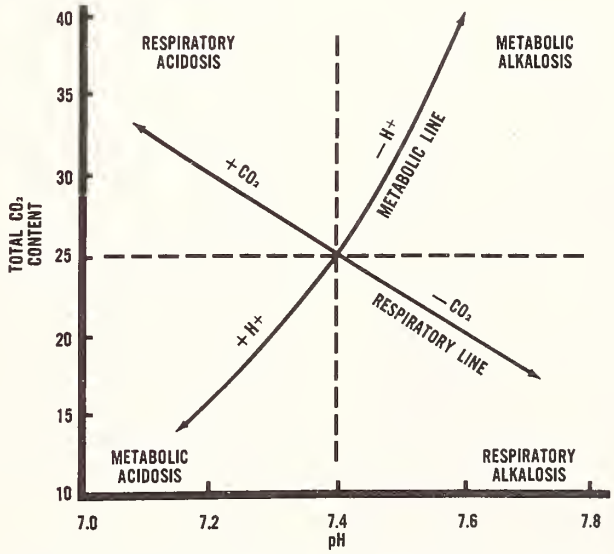

FIGURE 1.—The total CO_2 content or bicarbonate is plotted on the vertical axis and the pH on the horizontal axis. Changes in hydrogen ion concentration alone result in shifts along the metabolic line whereas changes in respiration or pCO_2 alone result in shifts along the respiratory line.

dotted lines represent the normal pH of 7.4 and total CO_2 content of 25 mM/L. When hydrogen ion or fixed acid is added to the blood, as in renal failure or diabetic ketoacidosis, or when bicarbonate is lost, as in diarrhea, pH and total CO_2 are lowered simultaneously. If there is no element of respiratory compensation, such a titration results in movement along the metabolic line with development of a metabolic acidosis. When hydrogen ion is lost, such as in persistent vomiting, movement is in the opposite direction with development of a metabolic alkalosis.

When CO_2 is retained in the blood by increasing pCO_2, as seen in chronic respiratory disease, it is hydrated to carbonic acid and results in a fall in pH and an increase in total CO_2 content. This results in titration along the respiratory line and is termed a respiratory acidosis. Conversely, with hyperventilation, pH rises and total CO_2 content falls, resulting in a respiratory alkalosis.

If hydrogen ion is added or removed without change in ventilation so that the pCO_2 remains 40 mm. Hg., movement is strictly along the metabolic line. This is rarely seen because respiratory compensations are made to return the pH toward normal as seen in Figure 2. This case illustrates the changes in acid-base balance occurring in a patient with metabolic acidosis and compensatory hyperventilation. The pCO_2 is lowered, allowing dissipation of carbonic acid which further decreases total CO_2 content.

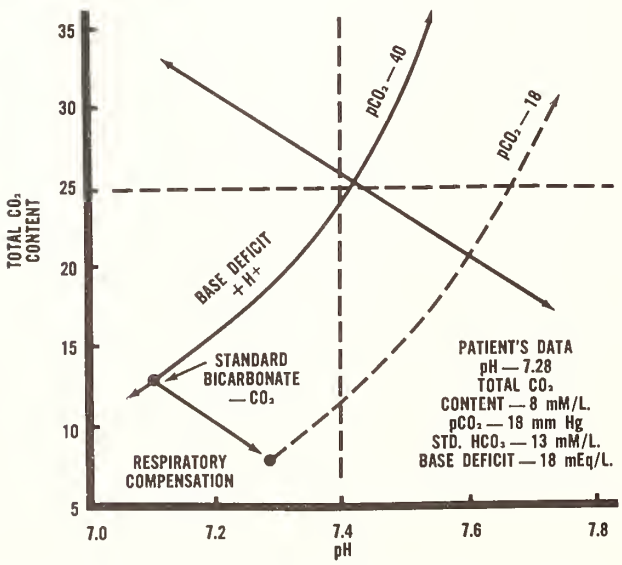

FIGURE 2.—The total CO_2 content or bicarbonate is plotted on the vertical axis and the pH on the horizontal axis. This represents data collected on a patient with metabolic acidosis and respiratory compensation using Astrup terminology.

In the conventional descriptions of acid-base disturbances, the pH, total CO_2 content and pCO_2 levels have been used to describe the status of the patient. The pCO_2 is a direct measure of the respiratory component in any set of measurements. Neither the pH nor total CO_2 content, however, directly quantify the metabolic component in any acid-base problem.

In 1948, Singer and Hastings introduced whole blood buffer base as a parameter for measuring the metabolic component. This is a quantification of cations associated with bicarbonate and protein buffers in the blood.

More recently, Astrup, Siggard-Anderson and their collaborators in Denmark have directly quantified the metabolic component of acid-base shifts using the terms *base excess* and *base deficit* (Astrup et al., 1960; Siggard-Anderson et al., 1960). They first determine the standard bicarbonate, as shown in Figure 2, which is defined as the concentration of bicarbonate or total CO_2 in the blood after fully oxygenated whole blood has been equilibrated at a pCO_2 or 40 mm. of Hg. at 38° C. If the illustrated patient's blood was equilibrated under these conditions, it would have been 13 mM/L.

The base excess or deficit, then, is the amount of NaOH or HCl required to titrate the blood to a pH of 7.4. This can be calculated or determined from a nomogram. Since a volume of red cells has a greater buffer capacity than does plasma, computation of base excess or deficit is also dependent upon a knowledge of the hematocrit or hemoglobin concentration of the blood sample.

The advantages of this system are two: (1) it provides one with a direct measure of the metabolic shift in any acid-base disturbance by removing the respiratory component, and (2) acid-base balance in any patient can be determined by measuring blood pH first, as the blood is collected, and second, after equilibration with gas bubbled through the sample at a pCO_2 of 40 mm. (or more commonly at several pCO_2 tensions such as 20 and 60 mm. Hg.).

From the multiple pH determinations, pCO_2 and total CO_2 content or bicarbonate can be calculated or determined from a nomogram. Since the blood pH is the most rapid and accurate of the three determinations used in evaluation of acid-base balance, this simplifies quantification of these disturbances.

The Astrup approach has gained wide favor as evidenced by the increasing number of papers in all fields of medicine that utilize this technique. This popularity is in part due to the precision and ease with which the standard bicarbonate and base excess or deficit can be obtained from blood pH determinations alone, and in part to the recent growth of interest in clinical disturbances of acid-base balance.

Schwartz and Relman (1963) ignited a controversy when they published a discussion of measures of acid-base equilibrium and acknowledged that the above mentioned measurements were useful in defining the metabolic shifts occurring as present *in vitro*. They question whether the clinician is aided by these new measurements since they fail to indicate what will occur *in vivo* where intracellular buffer systems also are operative. They further question whether the new measurements have any advantage over the more traditional system utilizing pH, pCO_2 and total CO_2 content or bicarbonate concentration.

Metabolic Acidosis

The combination of a low pH and total CO_2 content is indicative of a metabolic acidosis (see Figure 1). A metabolic acidosis can arise from: (1) addition of acid to or loss of alkali from the body fluids more rapidly than the kidney can excrete the acid load; (2) impairment in the capacity of the kidney to excrete acid; or (3) very commonly, a combination of both.

Causes of Metabolic Acidosis

It is useful in any given patient with a metabolic acidosis to determine if an "anion gap" exists. In the normal person, the differences between sodium concentration and the sum of the chloride and bicarbonate concentrations is 12 to 18 mEq/L. This difference represents anions in the plasma not commonly measured. When the difference is larger, an "anion gap" exists indicating excessive accumulation of organic (lactate, acetoacetate, salicylate, formate, etc.) or inorganic (phosphate, sulfate) anions. The classification of a metabolic acidosis can be divided into two groups, one with an "anion gap" and one without a "gap", as follows:

1. *With "anion gap"*
   - A. Azotemic renal failure
   - B. Diabetic ketoacidosis
   - C. Starvation and related syndromes (fever, thyrotoxicosis
   - D. Methyl alcohol intoxication
   - E. Paraldehyde intoxication
   - F. Ethylene glycol intoxication
   - G. Salicylate intoxication
   - H. Lactic acidosis
     - (1) Phenformin administration
     - (2) Circulatory insufficiency and shock
     - (3) Primary
2. *Without "anion gap"*
   - A. Diarrhea and fistula drainage (loss of bicarbonate)
   - B. NH_4Cl ingestion or infusion
   - C. Renal tubular acidosis, congenital and acquired
   - D. Ureterosigmoidostomy

The most common causes of acidosis in elderly patients are renal insufficiency, diabetic ketoacidosis and loss of bicarbonate with diarrhea of fistula drainage. In patients with shock, a lactic acidosis may develop. Nevertheless, in any patient presenting with an acidosis, steps should be taken to exclude poisoning with the various drugs mentioned.

A metabolic acidosis is generally asymptomatic until the CO_2 content falls below 18 mEq/L. The patient may then complain of weakness, malaise, dull headache, nausea, vomiting and abdominal pain. Characteristic deep respirations (Kussmaul breathing) are usually present. The rest of the clinical picture usually depends on the cause of the acidosis. Diabetic acidosis is usually associated with severe dehydration producing dry mucous membranes, loss of skin turgor and shock. Hyperglycemia, ketonemia, glycosuria and ketonuria also are present. Uremic patients have characteristic findings of uriniferous odor to the breath, muscular twitching and uremia.

Treatment varies with the cause of the acidosis. In renal failure, an attempt is made to limit exogenous protein intake by dietary limitations, and endogenous protein catabolism by high carbohydrate and fat intake. Since most of the 60–100 mEq of hydrogen ion accumulated by the body daily comes from protein catabolism, i.e. oxidation of sulfur and phosphorus, these dietary maneuvers are useful in decreasing the acid load presented to the kidneys. Sodium bicarbonate can be administrated orally or parenterally to correct the acidosis, but often one is limited in its use by the overhydration from salt and water retention

that may develop. Peritoneal or hemodialysis may be required if this occurs. The treatment of diabetic acidosis is discussed elsewhere.

Metabolic Alkalosis

A metabolic alkalosis results from excessive intake of alkali or abnormal losses of acid, e.g. pernicious vomiting. The kidney has the capacity to excrete large amounts of bicarbonate with associated cation so that significant alkalosis usually occurs only after sufficient dehydration to impair renal function. Alkalosis also occurs with potassium depletion due to: (1) a shift of acid from the extracellular to intracellular compartments in exchange for potassium; and (2) an increase in the exchange of hydrogen ion for sodium ion in the distal nephron. Since a competition exists between potassium and hydrogen ion for secretion in the distal nephron in exchange for the sodium reabsorbed, the decrease in available potassium seen in hypokalemia results in an increase in hydrogen ion secretion.

Often correction of the metabolic alkalosis can be accomplished by expansion of the depleted extracellular fluid volume with normal saline. Chloride is retained and the excess sodium is excreted in the urine as sodium bicarbonate. Ammonium chloride can be given orally or parenterally but is usually unnecessary. The correction of the alkalosis may be difficult to accomplish if hypokalemia is present until potassium is simultaneously repleted. Potassium should be given as the chloride salt in order to more quickly correct the alkalosis.

Respiratory Acidosis

Respiratory acidosis results from CO_2 retention. Pulmonary disease with impaired ventilation-perfusion dynamics and hypoventilation due to respiratory center pathology may produce CO_2 retention. Inhalation of high concentrations of oxygen by patients with chronic pulmonary insufficiency may accentuate the respiratory acidosis. The fall in pH is partially compensated by increasing urinary loss of ammonium chloride.

Treatment consists of aiding the ventilation with any of a variety of mechanical devices. Caution must be exercised to insure that acute hyperventilation without replacement of lost chloride does not result in a lethal alkalosis. Potassium replacement may also be necessary.

Respiratory Alkalosis

Respiratory alkalosis is produced by hyperventilation and is seen primarily in patients with emotional disturbances, central nervous system lesions and cirrhosis. Anxiety with hyperventilation is common at all ages, and patients may complain of dyspnea or "smothering," lightheadedness (or even syncope), numbness and tingling in the extremities, and chest pain or discomfort. Severe hyperventilation and alkalosis may result in tetany. Difficulty may be encountered in differentiating this "hyperventilation syndrome" from organic pathology such as congestive heart failure of pulmonary insufficiency. Treatment is aimed at relieving the anxiety in the patient and assuring him that, while his symptoms may be real, they are not life-threatening.

HYPOCALCEMIA AND HYPERCALCEMIA

Hypocalcemia

The most prominent manifestation of hypocalcemia is tetany. Numbness and tingling of the fingers, toes and perioral region and muscle cramps or spasms also are common complaints. Involvement of laryngeal muscles may produce a stridor stimulating asthma. Abdominal cramps, nausea, vomiting, diarrhea, fatigue, depression, psychotic behavior, delirium, generalized convulsions and papilledema also may be part of the presenting spectrum. Characteristic skin and fingernail changes, hair loss, cataract formation and dentition abnormalities occur in persons with long-standing hypocalcemia.

Causes of Hypocalcemia

Evaluation of a patient presenting with hypocalcemia requires differentiation of the following:

1. Inadequate calcium intake or absorption
   - A. Deficient calcium intake
   - B. Hypovitaminosis D
   - C. Vitamin D-resistant rickets[1]
2. Excessive gastrointestinal calcium loss (osteomalacia)
   - A. Chronic pancreatitis with steatorrhea
   - B. Sprue, tropical and idiopathic, with steatorrhea

3. Excessive urinary calcium loss
   A. Renal tubular acidosis
   B. Fanconi syndrome
   C. Vitamin D-resistant rickets[1]
4. Associated with elevated serum phosphorus
   A. Uremia (renal insufficiency)
   B. Hypoparathyroidism

Most of the patients with hypocalcemia have this disorder established before they reach old age. The major exception is the patient with terminal renal disease. Acidosis usually accompanies the hypocalcemia of renal insufficiency; therefore, most of the serum calcium is in the ionized form and symptoms of hypocalcemia are uncommon. Tetany rarely occurs unless attempts are made to rapidly correct the acidosis without giving supplemental calcium. Bone demineralization in these patients may result from decreased gastrointestinal calcium absorption (osteomalacia) or from secondary hyperparathyroidism. Bone demineralization would be expected in all of the above entities except hypoparathyroidism.

Therapy in all instances would consist of ingestion of oral calcium lactate or gluconate and use of vitamin D or its analogs. Pharmacologic doses, up to 200,000 I.U. of vitamin D per day, may be necessary for adequate therapy. It is important to monitor serum calcium levels to determine the appropriate dosage and avoid overtreatment and toxicity. Adequate levels of therapy are determined by serial determinations of serum calcium and evaluation of bone demineralization by X-ray. In patients with hyperphosphatemia (category 4), phosphate reabsorption from the gastrointestinal tract can be reduced by ingestion of nonabsorbable antacids (Basaljel) with meals to bind phosphate.

Hypercalcemia

One of the earliest clinical manifestations of hypercalcemia is an inability to concentrate the urine resulting in polyuria and polydipsia. Recurrent stone formation may be a presenting symptom. Later, symptoms of nausea, vomiting, constipation, abdominal discomfort, weakness, lethargy, drowsiness, mental confusion and toxic psychosis are common. These generally do not become manifest until the serum calcium exceeds 14 mg.%. Azotemia develops if hypercalcemia remains uncorrected—initially reversible but later becoming irreversible.

Causes of Hypercalcemia

Hypercalcemia basically may develop from either (1) excessive absorption of calcium from the GI tract, or (2) from increased bone reabsorption as follows:

1. Excessive absorption of calcium
   A. Milk-alkali syndrome
   B. Vitamin D intoxication
   C. Sarcoidosis
2. Increased reabsorption of bone
   A. Hyperparathyroidism
   B. Multiple myeloma
   C. Metastatic malignancies with or without bone metastases
   D. Hyperthyroidism
   E. Immobilization
   F. Active phase of Paget's disease.

In older persons, the most common causes of hypercalcemia are malignancy with bone metastases and multiple myeloma; however, hyperparathyroidism is also fairly common. The last should be considered in any patient with recurrent urinary stone formation, extensive bone demineralization or intractable ulcer symptoms. In hyperparathyroidism, serum phosphorus is generally low if azotemia is not present; in the other entities, serum phosphorus tends to remain normal. The diagnostic workup of the hypercalcemic patient is aimed at confirming or excluding the above disorders. Administration of low-dose corticosteroids, i.e. 20 mg. of Prednisone daily, is useful both as a diagnostic tool and as therapy. Only patients with hyperparathyroidism fail to lower serum calcium levels following steroid administration. Several recent reports indicate that even some of these patients may show some decrease in serum calcium levels with steroids. Other therapy for hypercalcemia, in addition to correction of the underlying disorder, includes infusion of either sodium phosphate or sulfate (Goldsmith and Ingbar, 1966; Chakmakjian and Bethune, 1966), and in extreme emergencies, peritoneal or hemodialysis. Hydration to maintain large urine volumes is a most important aspect of therapy.

[1] *Some disagreement exists in the literature about the nature of the defect in vitamin D-resistant rickets. It appears likely that the primary defect is a decreased gastrointestinal absorption of calcium; however, some individuals maintain it is a hyperphosphaturia due to a renal tubular defect. The evidence suggests that the hyperphosphaturia may be due to secondary hyperparathyroidism.*

HYPOMAGNESEMIA AND HYPERMAGNESEMIA

Hypomagnesemia

The clinical manifestations of magnesium deficiency primarily are neuromuscular and central nervous system hyperirritability. Hyperflexia, tremor, disorientation, confusion, hallucinations, convulsions, hypertension and tachycardia may be seen.

Hypomagnesemia may result from gastrointestinal fluid losses, vigorous diuretic therapy, acute pancreatitis, primary hyperaldosteronism, treated diabetic acidosis, hypoparathyroidism and hypercalcemia. Low serum magnesium levels are commonly seen in chronic alcoholics. This is probably due to an inadequate intake, loss in diarrheal stools and an accentuated loss in the urine directly related to ethanol ingestion. It is unclear what relationship hypomagnesemia bears to the clinical syndrome of delirium tremens.

Magnesium salts, up to 8 gm. daily, may be safely administered orally, intramuscularly or in intravenous infusions provided that oliguria is not present. After correction of any deficit, 1 gm. daily easily provides maintenance therapy unless abnormal losses continue.

Hypermagnesemia

Hypermagnesemia is primarily a problem of patients with renal disease. The administration of magnesium to patients with chronic renal failure via milk of magnesia or magnesium sulfate enemas may produce symptoms of central nervous system depression or cardiovascular conduction abnormalities. Peritoneal or hemodialysis rarely is indicated for hypermagnesemia alone, however, lowering of serum magnesium may be a secondary benefit.

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METABOLISM, HOMEOSTASIS AND THE OLDER PATIENT

By

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INTRODUCTION

During the past three or more decades, clinical scientists and health practitioners have become increasingly concerned with the elderly segment of the population for a variety of reasons, including its numerical increase. As a consequence, more clinical interest is apparent now than ever before, more is being written, and the scientific literature has begun to fill with information on the occurrence of disease and illness in older people.

In the light of accelerating interest and activity in the subject area, an answer must be provided to this basic question: Does disease and illness in the elderly differ in any significant way from disease and illness in younger people? This question relates to both pathological and clinical aspects of disease, as well as to the existence of structural and/or functional manifestations which, from the practitioner's point of view, set the old person apart from the younger individual.

Elsewhere in this volume, an array of disease states and their accompanying illnesses are discussed at the clinical level. However, a true understanding of many of these diseases, their causes and results in the older person, requires more than knowledge of the pathology involved and the clinical picture presented. Parenthetically, it is well known that structural changes in the old person, which can indubitably be looked upon by the clinician as a function of time, are not overtly prominent. The most tangible of these are best known to the biologist and physiologist and consist of extracellular changes in collagen and ground substance and the disappearance of cells from nondividing or postmitotic tissues. But here we must be concerned not only with such time-dependent morphological changes but also, and more importantly, with physiological results that these changes may impose upon the course of disease and sickness in the elderly person. It is the imposition of these influences which captures the interest and energies of many who work in this field.

Each of the illnesses arising from pathological states in older people is almost certainly affected by many influences, including those relating to metabolism and homeostasis. This is true for persons of all age groups, but particularly is it so for those of advanced years.

In the past three decades, intensive study has been made of many physiological processes which directly relate to disease and illness among the elderly; findings reveal wide variations in manifestations of these processes which appear to be very definitely age-related. Some functions are well maintained from youth into very late life, whereas others show a trend of gradual reduction during middle and late adulthood. There are still other functions which, when measured under resting conditions, give evidence of remaining remarkably stable throughout the lifespan, but when subjected to specific stress, demonstrate a response in the older person which is quite different from that seen in the young. It is apparent, therefore, that many potential physiologic reactions, brought about or influenced by time-related changes, are ever present in the elderly person and stand ready to become manifest, particularly when the older individual is subjected to the stress of disease and illness. It is because of this that the clinical manifestations and course of much illness in the older person may be thought very reasonably to be set apart from that in the young and to be looked upon as having special features.

An essential visible characteristic of the older person is a gradual slowing down of most voluntary activities including the speed, accuracy, endurance and strength of motion. This slowing down of voluntary activity as well as that of some involuntary activity may justifiably be looked upon as related to slowing down of various metabolic processes. Many of these physical processes have been extensively investigated at the same time that others, which are primarily concerned with psychological or behavioral aspects of aging, have been examined (Shock, 1955-a).

CELL MASS AND OXYGEN CONSUMPTION

One of the earliest physiological observations having tangible relation to clinical problems of the elderly person was made by Boothby and co-workers (1936) more than 30 years ago. This investigation showed

that basal oxygen consumption (BMR) gradually became lowered with advancing age, an observation which was later confirmed in a number of laboratories including those of Robertson and Reid (1952) and Shock and Yiengst (1952, 1955). This gradual lowering of basal metabolism was at first thought to be related to diminution in thyroid function and in these early studies, computations were made in the usual manner by relating oxygen consumption to surface area, arrived at by the formula employing body weight and height.

It is of interest to record here that findings made on animals do not parallel those made from observations of humans. Ring and co-workers (1964) found that oxygen consumption by rats actually increases with advancing age but offered no satisfactory explanation for this difference from humans. Bertolini (1966) has also expressed the view that alterations in metabolism with senescence are not uniform between different animal species nor indeed between tissues and organs of the same species.

On further investigations of the lowered oxygen consumption in aged humans, observations have been made which in an indirect way, remove it from any question of primary thyroid influence. These investigations showed that with advancing age there is progressive reduction in total body water; because of the stability of extracellular water, the deduction is made that this lowering of body fluid is confined to the intracellular compartment (Olbrich and Woodford-Williams, 1956). Taking this a step further, when oxygen consumption is equated with intracellular water rather than surface area (body weight and height), no reduction with advancing age is found.

This series of findings has led to the conclusion that in the aged person oxygen consumption per unit of metabolizing tissue must be essentially the same as that in the young (Shock et al., 1953). Moreover, since intracellular water may be accepted as a measure of tissue mass which is actively metabolizing, the reduction in oxygen uptake by older people must reflect the time-wise loss of metabolically active cell mass.

The indication that the body's store of intracellular water can be accepted as an index of the mass of metabolizing tissue has been given support by results of studies utilizing whole body potassium as a measure for this (Forbes, 1963; Allen et al., 1960). Though the evidence that has come from use of body potassium is not completely conclusive, it too indicates a very likely reduction in the volume of metabolically active cell mass in the aged.

The findings derived from these two methods of study, intracellular water and body potassium, support the long-held opinion that a major change in body composition of the older person consists of loss in lean body mass. There is also general agreement that any increase in organ or body weight in advanced age is almost certainly due to either fat accumulation or fluid retention (Bourne, 1960).

The conclusion that loss in high oxygen utilizing cell mass is a natural consequence of aging brings into focus the question of localization of this loss. For this, one must theoretically look: (1) to those body systems where normally there is considerable tissue mass; (2) where there is little or no cell reduplication and therefore a resultant time-wise cell loss; and (3) where the cellular activity is normally of high oxygen consumption. Of all body structures the mass of skeletal muscle seems to meet these criteria more completely than does any other single organ system. Others fall short for a variety of reasons.

Even though neurones do not reduplicate themselves and loss of brain weight is an accepted accompaniment of aging, the total mass of the central nervous system is relatively small. The abdominal organs, composed principally of the gastrointestinal tract, are known generally to have the capacity for cell division and also to retain their size throughout life as well. The skeletal system characteristically loses weight when it becomes osteoporotic because of mineral loss, and in this event the important role of the osteoblast is obviously of concern. But calcium retention in the bones and calcium loss are complicated and poorly understood phenomena, and at this time there is no certainty where osteoblastic activity, or lack of it, fits in. Though loss of body weight does certainly take place under these conditions in the old person, it is unlikely that it is due to loss of bone cell mass to any considerable extent.

The voluntary muscle system, therefore, appears to be the logical location where major loss in lean body mass does take place and this is in agreement with long-accepted views. In order to throw additional light on this, Yiengst and co-workers (1959) studied the skeletal muscle of rats of different ages and found that there were distinct decrements with advanced age in the mass of muscle and its content of intracellular water, nitrogen, potassium and phosphorous. The au-

thors attributed these findings to loss of muscle fibers. Unfortunately, precise information of this nature about aged humans is very sparse and it is not known, for instance, how large a quantitative loss there is, the conditions that may lead to it, and whether it is due to death of individual muscle units or reduction in their size or both. Even though it is agreed clinically that the musculature of the extremities of old people is generally smaller than that of the young, and even atrophic, good qualitative and quantitative supporting data are lacking.

Despite these gaps in knowledge, it must be assumed in the light of available information that the skeletal muscle system is probably the chief site of the important morphologic and physiologic manifestations of aging which are associated with reduction in oxygen consumption and alterations in metabolism. It is also reasonable to state that wherever the major loss in cell mass takes place, the reduction in overall body metabolism is almost surely a strong influence in bringing about lessened resistance to factors from which disease and illness arise and progress, and is an important element in bringing about the frailty of old age.

CONNECTIVE TISSUE AND METABOLISM

In addition to cell loss, considerable emphasis has been given to the important influence that alterations in connective tissue must play in the metabolism of the old person. The time-related changes in the physical and chemical nature particularly of collagen and ground substance have received much attention in the past two decades. It is now known that with the passage of time, cross linkages take place between collagen molecules giving rise to a variety of changes in that tissue's physical characteristics, including its solubility and various other properties (Kohn and Rollerson, 1958, 1959–a, 1959–b, 1960; Gross, 1958, 1964; Verzar, 1963).

It is also true that collagen increases in amount with aging which is attributed to both an increase in the diameter of existing fibers (banding together of fibrils) and the formation of new fibers (Lowther, 1963). This would appear to be a natural phenomenon in the body's effort at filling in those areas previously occupied by cells which have since died. Paralleling this, studies on ground substance, though not so conclusive, tend to indicate that there is also alteration in this component of connective tissue, including some reduction in the amount of it and a consequent change in the proportion of it to collagen (Sobel, 1967). In concert with these physicochemical changes, there is also reduction in the metabolic activity of old collagen as compared to young (Newberger and Slack, 1953; Sobel and Marmorsten, 1954; Van Slyde and Sinex, 1958) and of old ground substance as compared to young (Sobel, 1967).

It is difficult to believe that these extracellular changes do not influence the diffusion of oxygen and other nutrients from the blood into the cell and, in turn, the diffusion of various cellular metabolites from the cell into the blood stream (Ma and Cowdry, 1950). In this concept it is logical to visualize that in the aging mammalian organism, the development of increased amounts of collagenous tissue, along with the striking changes that take place in that which is already present, and the alterations in the physicochemical properties of ground substance result in factors which cannot help but influence overall body metabolism and certainly that of individual tissues and organs.

It must be said that the direct tissue observations which have been designed to determine levels of cellular metabolism with relation to age are not such that they can point up a clear relationship between the two at the present time. Only a modest amount of work with bovine cartilage has been done on this. Though these particular investigations have shown diminution in metabolic activity in cells of increasing age (Rosenthal et al., 1941), more confirmation is needed.

METABOLISM RATE OF LIVING AND LIFE EXPECTANCY

One approach to the study of metabolic influences in aging man has been through investigations of normal and abnormal metabolism in lower animal species. Among such studies have been those on the influence of certain environmental influences on metabolism and length of survival. Alterations in environmental temperature have been used with particular productivity in some aspects of this. For instance, fish and other water life have a body temperature about the same as that of their environment, and with a rise in environmental temperature, the temperature of the body also rises, accompanied by a rise in metabolism. Associated with this, senescent changes proceed more rapidly and life expectancy is substantially shortened. From these

observations has come the view that aging is less a matter of elapsed time than the rate of living during a given interval (Bouliere, 1957).

Obviously, overall metabolic activity is an expression of rate of living, and when carried on at abnormal speed for an excessive period, damaging results accrue. This means that when energy expenditure is of such a magnitude that tissue loss becomes a factor, the end results cannot but help to deplete the organism and reduce longevity. It is generally agreed that in both vertebrates and invertebrates there is an inverse relation between metabolic rate and its associated relative speed of growth and duration of life (Bouliere, 1957). From this it does appear that rate of metabolism in youth may indeed influence rate of senescence even though in advanced age metabolic activity becomes lessened.

ANABOLISM AND CATABOLISM

Worrell (1957), in a discussion of aging and metabolism, has expressed the view that length of adult life in man is a function of three variables: (1) energy turnover; (2) net loss of protein per unit of energy turnover; and (3) minimum amount of protein required to sustain life. In accordance with these variables, it is quite evident that energy turnover and the gain or loss of protein are geared to the magnitude of synthesis and degradation of body protein and perhaps other tissues. In the growing mammal an excess of protein formation over protein breakdown is a fundamental requisite.

Lansing (1952) has pointed out that living things differ from inorganic objects in their ability to reconstitute themselves. In this context, therefore, aging becomes a wearing-out process due to a decrease in efficiency for reconstitution. Expressed in another way, aging changes depend upon the organism's decline in its synthesizing capacity and/or an increase in its degradative functions.

This concept of turnover or metabolism supports the thesis that in youth, anabolic activity is greater than catabolic activity, and at that time of life there is a dynamic balance between the two. This results in both the building of new tissues and in the replacement of those constituents which have been lost. On the other hand, in advanced age an imbalance between anabolism and catabolism exists with reduction in the former and an increase in the latter, along with consequent slowing of the building processes. In this system, it is quite evident that there is an inverse ratio between rate of metabolism and a specific life period as is the relationship of synthesis to degradation. In early life, both rate of anabolism and consequent synthesis are high in critical tissues; in advanced life, anabolic rate is slowed, synthesis is low and catabolism becomes predominant.

Factors which influence, and are the result of the rate of metabolic reactions may be expressed in the following table from White (1960).

SYNTHETIC REACTIONS (*Anabolism*)	DEGRADATIVE REACTIONS (*Catabolism*)
1. Substrate availability.	1. Substrate availability.
2. Enzyme concentration.	2. Enzyme concentration.
3. Energy requirements.	3. Energy expenditure.
4. Product removal.	4. Product accumulation.
5. Regulatory mechanisms (hormones).	5. Regulatory mechanisms (hormones).

It is quite evident from this table that qualitatively the difference between these two reactions is the storage of energy and removal of metabolic products during synthesis, and the expenditure of energy and accumulation of metabolic products during degradation. Mechanisms that control these reactions are of course unknown, but there is popular belief that much is under hormonal control. The thesis has been proposed that in aging, the diminution in sex hormone production gives rise to altered endocrine balances and therefore altered metabolic processes in tissues (White, 1960). The diminished availability of androgenic steroids in late life may well result in diminution in the anabolic side of metabolic balance.

HORMONES AND METABOLISM

The place of hormones in general and their role in metabolism have long been thought to be of vital influence in the aging problem. Specific glandular secretions have received special attention in this regard and the earliest investigations were perhaps focused on the role of the thyroid. Some of the opinion about thyroid influence was stimulated by the belief that the lowered

basal metabolic rate with increased age was thyroid dependent. As has been previously pointed out, however, this thought has been discarded by most observers, largely because determinations of thyroid function in a variety of other ways are normal in older people, and these include blood protein bound iodine, uptake of I_{131} by the thyroid, and the response of the thyroid to administration of a maximal amount of thyroid stimulating hormone (Shock, 1968). In addition, there are other explanations for the lowered BMR as has been discussed in a previous section.

On the other hand, the aged individual may be subject to metabolic changes mediated through the secretion of some of the other endocrine glands. There seems to be general agreement that in advancing years there is a drop in gonadal hormone secretion, with concomitant persistent adrenal corticosteroid production. The combination of these phenomena should theoretically result in an increase in catabolic activity (Gherondache et al., 1967) with its resultant effect on protein and calcium metabolism and balance.

In the relation of hormones to metabolism, attention has also been called to the fact that secretory activity of some glands is regulated by the process which it is supposed to control. To illustrate: parathyroid secretion is stepped up or tamped down by the blood calcium level; insulin production is normally influenced by the blood sugar level; secretions of the anterior pituitary are largely controlled by the end organ to be affected (thyroid, adrenal cortex, gonads). Also affecting hormone production are environmental factors such as the stimulation of thyroid and adrenal cortex activity by exposure to cold. Endocrine balance is therefore always in a dynamic state, constantly changing and shifting (Dempsey, 1952).

A major impediment to determination of the roles of hormones on metabolism is directly related to lack of a basic methodology which will accurately depict the true glandular secretory response in a given situation. This is particularly true in the case of elderly persons because variables which influence a given method are likely to be greater in them than in younger individuals. Urinary measurement of steroid excretion, for instance, has been an accepted avenue of approach, but it is never known whether the steroid which appears in the urine was the same prior to its passing through the kidney, and therefore provided an identical hormonal environment to the body's cells. Be that as it may, the excretion of certain steroids in the urine appears to diminish with advancing age, as well as under chronic stressful conditions (Pincus, 1955).

Theoretically, a more meaningful method of assessment might be by measurement of plasma levels of hormones, and indeed such procedures have been achieved in a good many instances. But here again, serious questions arise about the meaning of a given blood value at a given point in time. Blood levels may obviously be influenced by the gland's volume and speed of secretion, by the movement of the hormone from the blood into the extravascular spaces, and by the rate of its excretion in the urine. It is patently evident that all manner of intrinsic and extrinsic factors influence the gland's secretory activity. An increased accumulation of colagenous connective tissue and a greater density of ground substance may result in a slowing down in the equilibration between blood and extravascular tissue; a reduction in renal function may result in lessened steroid excretion and consequent higher blood values. These influences, separately and collectively, may seriously jeopardize the values of plasma levels of any hormone as truly representative of specific glandular activity. It may be therefore necessary to look to the future for better ways by which biological assays can more accurately reflect the true state of glandular activity.

HOMEOSTASIS

Cannon (1929) originally proposed as a definition for homeostasis "the totality of steady states maintained in an organism through the coordination of its complex physiological processes." This definition stands solidly today.

Peterson (1965), in a simplified version of a system of physiological controls, has described the mechanism for this to consist essentially of three parts:

1. The *sensor* or that part which is uniquely responsive to the function to be regulated;
2. The *error signal* or that part which is the mechanism that compares the real value of the function to what it should be;
3. The *regulating system* or that part which controls the function and decreases or increases its value by manipulating those controls.

It is very evident that in these, there are the essential ingredients of the homeostatic mechanism and disruption of any one of them may result in faulty control.

In relation to this and the foregoing discussion on changes in tissues and metabolism with increasing age, it is pertinent to recall the proposal that a similarity exists between the life course of man and the triphasic course portrayed in the phenomenon of stress (Selye and Pioreschi, 1960). The general adaptation syndrome (GAS) reaction to stress is described as consisting of three phases: (1) the alarm reaction; (2) the stage of resistance; and (3) the stage of exhaustion.

The third or exhaustion phase of the syndrome has been equated with the late stages of mammalian life in which there is a lack of capacity for responsiveness to particular stimuli or, expressed in another way, a reduction in ability for homeostasis. It is within the framework of these concepts, namely, (1) the necessity for physiological control in the presence of displacement by an untoward stimulus and (2) the similarity of the aged person to the exhaustion phase of the alarm reaction, that the altered metabolism of the older person eventually makes itself felt.

There is every reason to believe that the probability of death from any disease is distinctly enhanced in the older person by these alterations in physiologic controls that may lead to more profound effects from disease. In the present state of knowledge, biologic mechanisms which are responsible for these alterations in physiologic control are not well understood. But it is believed that progress is being made in this direction, both in a general sense and with respect to specific disease states. The loss of homeostatic mechanisms may well explain almost the entire phenomenon of increasing debility and death rate in the older person (Kohn, 1963).

Maintenance of uniformity in the internal environment of the individual certainly is a necessary goal in the preservation of health and life. There are first and second lines of defense against displacement from this uniformity. First, there is the hypothalamus which is the center of the vegetative nervous system; second, there is the anterior pituitary which is the chief coordinator of those endocrine glands concerned in the process (Shock, 1952). Reduction in capacities of these defense mechanisms is doubtlessly at the root of this problem, but as yet not enough is known about the basic processes to elucidate them completely.

A number of physiologic reactions to displacement stimuli have thrown considerable light on the faulty adaptation of the older person to certain of these. Observations made upon temperature regulation reveal that there is a gradually restricted process of adjustment to both high and low temperatures by the older subject. In this, it has been shown that limits of adaptation become increasingly narrower from the seventh decade on. Factors which may influence this are lessened heat production (metabolism), impairment of heat loss through the skin, lessened muscular activity, altered responsiveness of tissues to thyroid hormone and probably many others (Shock, 1952). It is obvious that a displacement stimulus which does not receive a proper response from one or more regulatory mechanisms results in uncontrolled alterations. The above temperature problem is an example.

Many physiological characteristics of the elderly person are constant and unchanged from comparable values seen in youth. Examples of such characteristics are: the formed elements of the blood plasma volume (Yiengst and Shock, 1962); fasting arterial blood sugar (Smith and Shock, 1949); and arterial blood pH (Shock and Yiengst, 1950).

On the other hand, there are characteristics of the elderly person which show definite evidence of deviation from those values seen in youth. Some of these are: a decline in resting cardiac output (Brandfonbrenner et al., 1955); an increase in blood pressure (U.S. Public Health Service, 1964); a reduction in concentrating ability of the kidneys and of urea clearance (Lewis and Alving, 1938); and reduction in renal blood flow (Watkins and Shock, 1955), glomerular filtration (Davies and Shock, 1950), excretory function of the kidneys (Davies and Shock, 1950), and tubular reabsorptive capacities (Miller et al., 1952).

The pulmonary system also shows deviant physiological values in the elderly as compared to the young. Principal among these are: reductions in vital capacity, maximum breathing capacity and total lung capacity; and an increase in residual volume (Norris et al., 1956). Diffusing capacity of the lungs is also believed to be reduced (Cohn, 1964), as is pulmonary compliance (Mittman et al., 1965).

Thus it is that there are many physiological reactions in older people which, when compared to those of youth, demonstrate something less than optimum performance. It seems very reasonable to suppose that within this framework the ability of the older individual to withstand stress of illness or accident is seriously impaired.

But even more visible than these are illustrations of faulty homeostasis in older persons in which there are manifestations of abnormal physiologic responses to specific stimuli. The simplest of these is the reaction of

cardiac rate and respiratory volume to the stimulus of physical work. Both of these require a longer period of readjustment to normal in the older individual (Norris and Shock, 1960). More complicated are the reactions to displacement of the blood pH by administration of ammonium chloride (Shock and Yiengst, 1948) and of blood sugar levels after administration of glucose (Silverstone et al., 1957). In both of these instances, the magnitude of the reaction to a standard stimulus is greater in older people and their rate of adjustment to normal is slower. In the case of glucose metabolism, this assumes a very practical dimension since the characteristics of the reaction in normal older people closely resembles that seen in persons with diabetes mellitus.

SUMMARY

In summarizing the clinical impact of metabolism and of homeostasis on the older patient, a first consideration should be given to those time-dependent physical changes which are believed to influence this impact. The principal changes are loss in high oxygen consuming cell mass and critical physicochemical changes in connective tissue. With these there is reduction in overall body metabolism, chiefly manifested by a drop in oxygen consumption as well as a likely interference with exchange of oxygen and nutrients and metabolites between cell and blood stream.

Changes in intercellular connective tissue obviously can occur anywhere in the body, but it appears that the chief victim of loss in cell mass is the skeletal muscle system. It is in this system that there is a large part of the body's store of high oxygen utilizing cell mass which is incapable of reduplicating itself. Loss of a portion of this mass from the reservoir of vital tissue naturally deprives the body of a major component of its defense mechanisms against disease and illness.

With the progression of age, the influence of the physical changes becomes more prominent and, as a result, the normal anabolic-catabolic relationship of youth is, at some point in time beyond maturity, replaced by an imbalance in which catabolism surpasses anabolism. In this phenomenon, the capacity for building and reduplicating tissue becomes markedly reduced in advanced age, and eventually man becomes increasingly vulnerable to such external stimuli as disease and illness and is unable to meet the demands imposed by these stimuli either in their prevention or cure.

There is every reason to think that during these events endocrine activity also becomes altered, with reduction in secretion of some glands and the continued and even increased secretion by others. It appears likely that the gonads and adrenals in particular are concerned in this, their activity being mediated to a considerable extent through the pituitary.

In this constellation of changes, there is clear evidence that there is a reduction in many physiological capacities of the older person, although not to the same degree in all. These reductions can mean only that, when taken together, there is loss of physiological reserve of wide proportions in these people, and this is almost certainly reflected in their lack of tolerance to stresses imposed by disease, sickness and injury. It may be surmised that important in the basic cause of these losses are imbedded factors already mentioned, namely the loss of metabolizing tissue of high oxygen utilization and the retarding influence of changes in the physical and chemical nature of intercellular tissue. Certainly both of these factors may be reflected in the loss of basic functioning units as in the case of the fiber in skeletal muscle, the neurone in the central nervous system, and the nephron in the kidney. Furthermore, it may be said that if a normal protein content of the body is significant for the maintenance of basic functioning units, then factors which influence protein homeostasis must be involved. If this is significant in the aging process, it would appear that the existence of an integrated balance of endocrine products may be very important to forestall these changes (White, 1956).

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SECTION B/CLINICAL PROBLEMS CLOSELY RELATED TO MULTIPLE ORGAN SYSTEMS

Part XI/Surgery

SURGICAL PRINCIPLES FOR THE AGED PATIENT

By

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INTRODUCTION

Medical care in the United States is a major national endeavor, and rightfully so, because good health is one of the greatest assets of any nation. Each individual, and the population now exceeds 201 million, contributes most when he is free of the burden that disease imposes. The extension of life, one of the by-products of this pursuit, is increasing the proportion of citizens who are over 65 years of age. There are now approximately 20 million who have reached this age, and statistical graphs indicate this trend will continue for some time.

This increase in the proportion of senior citizens in the total population is not solely the result of improved medical care but is dependent upon other factors as well. This country, since its beginning, has flourished on the development of its natural resources; although there have been lulls in the economic state, wealth has gradually increased. Paralleling this have been improved standards of living and, for most of the population, an abundance of food. Housing and living conditions have been improved. Hygiene and sanitation, the two great essentials to preventive medicine, have been extended to the rural sections as well as the cities.

Associated with the great development of the Nation's resources and its resultant economic prosperity has been a continual expansion of medical science facilities, including that of the basic sciences. Together they have contributed to the great advances that, in turn, have been rendered available through the building of new hospital and clinical facilities in almost every community of the United States.

Perhaps most important in this development have been the medical schools and their associated teaching hospitals which, with their research laboratories, have provided new areas of endeavor as well as new advancements that are practical in application to patient care. Government at the Federal, State and local levels has done much to provide funds and organization that have enabled the individual citizen to have the greatest benefit. Preventive medicine has been in the forefront of this continuing trend to improve the health of all age groups. Definitive therapy, both medical and surgical, has been expanded as a result of improvement in diagnostic measures and the evolution of methods to curtail and control disease.

We are concerned here with surgery, the developments of which have been spectacular since the turn of the century. These developments are spectacular not only because they have been elaborated and made more widely applicable, but also because they can be accomplished with minimal risk and less discomfort to the individual. The improvement in operative morbidity and mortality in 1971 as compared to that of 1900 is dramatic and, although it parallels overall improvements in medical care of all age groups, it is most striking in those who are 65 years of age and older.

Those who reach 65 years of age are subject to a wide range of disorders, many of which are best treated by surgery. A few decades ago, there was a tendency to withhold indicated surgery because of the anticipated risks that accompanied this therapy. However, medical knowledge in general has increased, as have ways and means to meet the problems that are peculiar to the aged. These have evolved from research laboratories and the careful recording of experiences with patients, as well as the dedicated and unrelenting

efforts of the medical profession together with the nurses and other paramedical groups. The most important advancements in the recent half century have been related to anesthesia, water and electrolyte balance, methods of measuring impaired function to determine the capacity of an individual to withstand a surgical procedure and, within the past decade, the replacement of organs that are beyond repair by transplantation or mechanical devices.

The aged, like the very young, have a rather slim margin of physiological functional reserve, even in a good state of health, and when they are ill from any disease process, this is further narrowed. An awareness of this on the part of the medical profession has been of fundamental importance in first estimating the reserve and then selecting the surgical procedure that meets the immediate critical situation in order that life may be prolonged, leaving definitive correction to be carried out on an elective basis. The increase in hospital beds, wide distribution of hospital facilities in communities, and the presence of a well-prepared physician, who has had the benefit of postgraduate training, have had a profound influence upon the care that the aged are now receiving. An appreciation of this on the part of the public at large, and those over 65 in particular, is reflected in their attitude towards hospitals. For example, many of those now over 65 recall that in their youth, hospitals were institutions where people went to die. This was because fewer returned well from them than is the case today. At present, hospitals are looked upon as a place of refuge. All gradations of illness are so well cared for that only a small percentage fail to return to the community.

The disease entities in the elderly requiring surgery are even more varied than those in the younger age groups. Examples of such disease entities include: changes in the vascular system associated with the aging process, such as obliterative vascular disease and cardiac insufficiency; carcinoma of practically every structure; impaired function of specific organs such as the lungs, pancreas and kidneys. In the process of evaluating these patients and seeking to help them, procedures have been evolved that are very valuable but always impose a burden upon the individual. These include visualization of the vascular system by X-ray, pulmonary function studies, direct tissue biopsy, and metabolic evaluations of critical processes in the digestive and excretory mechanisms of the body. Thus not only are the number and extent of surgical procedures for the elderly increasing, but also the methods of evaluating these individuals in preparation for these procedures. Together this constitutes an increase in the daily work of the general hospitals throughout the country which are almost without exception, participating in the care of the elderly group.

The magnitude of the problem relative to the care of those 65 and older becomes more distinct when it is approached in proper perspective. On the one hand, those 65 and older make up approximately 10 per cent of the population; on the other hand, requirements of the elderly for medical care—and for surgery in particular—require almost 50 per cent of the facilities of hospitals. According to data from the Metropolitan Life Insurance Company and the Associated Hospital Service of New York, an individual who is 65 years of age or older is much more likely to be admitted to the hospital than a person who is under 65 years of age. So far as the surgical patients in hospitals are concerned, the duration of their stay, because of the complexity of the problems associated with their care, is twice as long as for those of the younger and more robust period of life.

The task therefore of caring for the aged is currently a very major one in our hospitals. Undoubtedly there are many facets in the overall problem that can reduce the numerical magnitude of care and at the same time improve it from the standpoint of the individual patient. One of the reasons for the high proportion of hospital bed occupancy by this group is the lack of facilities to care for them at home, particularly the urban home; the apartments or houses where the aged usually live alone or with their spouse, children or grandchildren. An accident or illness that requires considerable continuing care cannot be provided for in these surroundings and the patient therefore is admitted to and remains in a hospital. When the surgical evaluation and procedure have been completed, the return home of this individual may be very difficult.

The period of hospitalization could and should be reduced for two reasons. The first is to free up hospital facilities for what they are particularly equipped to do, rather than have them used for custodial care. Second, a convalescent atmosphere and facility encourage the elderly patient toward complete rehabilitation much more effectively than the setting of a general surgical hospital pavilion with its seriously ill individuals.

The social, economic and cultural backgrounds of a cross section of people of this country are so diverse that many of the personal problems of the aged must rely on community activity for their solution. In rural

communities and small towns this is being well attained, but in the cities, which are growing both in number and size, individuals of divergent backgrounds are brought together, therefore giving rise to complex situations that are ignored, thus leaving the social services shouldered with the burden of solving them. Added to these are the conflicts that arise between ethnic groups which are reflected in individual constituents as they appear in the hospitals.

The surgical principles to be applied to the aged individual, while not unlike those applied to all other age groups, have many associated ramifications that require recognition, consideration and meticulous management. While these may primarily involve disease and the aging process of the physical being, which are often readily well-defined, thought and action are also required to recognize the factors of the environment from which the patient comes and the circumstances to which he will be exposed when the required surgical services of a general hospital have been satisfactorily fulfilled. It is the recognition of these on the part of the patient that frequently detracts from the benefits that surgical therapy may have provided. The will to live, the desire to plan for the future, the participation and enjoyment of events in ordinary life on the part of the aged tend to be drastically reduced in comparison to those of younger individuals.

THE DECISION TO PERFORM OR NOT TO PERFORM SURGERY

Patient Attitudes

There lingers still among the laity, the patients, and the medical profession definite inhibitions about embarking upon surgery in the elderly. These are based largely on experience in the past from a lay point of view, e.g. that of the patient. This age group recalls that hospitalization amongst those they knew in their communities was associated with a high mortality and high morbidity of complications when surgery was embarked upon. The hospitals of that era too often proved to be institutions of terminal care even when patients entered them for therapy aimed at extending life.

On the other hand, those individuals now 65 years and older, who know about hospitals through personal experience or experience of members of their families, now usually exhibit a different attitude and regard the hospital as the proper place to take care of major illness, whether medical or surgical. In addition, the increased availability of hospitals too has had a definite effect upon the thinking of the lay population so that this is also bringing about change. Thus, it is well to continually bear in mind the attitude of many of the elderly and the background that has given rise to it.

The attitude of the medical profession also has been concomitantly changing and perhaps more rapidly, particularly among the segments directly associated with hospital practice. They have had an opportunity to see what can be accomplished when steps are taken to reduce the risk of any surgical procedure. Unfortunately, there still remains a small proportion of the profession who, because of limited experience with hospitals, are prone to consider that it is perhaps better to let an elderly patient die of complications at home than to send him to a hospital where he will be subjected to prolonged examination and perhaps surgical operation with a relatively short life expectancy, even when these procedures are successful. This too has been influenced by past experience. Surgeons in large hospitals, in particular, would do well to sympathetically understand the position of the general practitioner who carries the elderly along during the period that they are having symptoms from a condition that might be corrected by elective surgery, and sends the patient to the hospital only when an emergency arises.

So far as the patient's attitude is concerned, the activities of the individual influence greatly his reaction when confronted with illness that carries an indication for surgical procedures. If the elderly individual is engaged in some activity that holds his interest or if he is participating in other problems so that he is well occupied, there is generally an acceptance of surgery without hesitation. This is a manifestation of the desire on his or her part to continue to be active and to continue to live as long as he can. This is in contrast to the elderly who have been restricted from ordinary activity either by illness or so-called "retirement."

Pertinent to this also is the appreciation on the part of the patient that many of his peers in age and past associations have died. This often influences him to consider that "his time is approaching" and that interference with the process by surgical measures, which he holds to be rather heroic, is not for him. In terms of the events of the day, elderly patients are usually much more interested in whether or not they can remain active to indulge in whatever they have been accustomed to or what has afforded them satisfaction or pleasure, rather than in the mere extension of the lifespan. Death in the

minds of many patients is an event in the vague future. They would rather not consider it, and seek to avoid thinking about it. It is rare for a patient to decide to have an operation because he believes he can live an additional specific length of time.

Different Problems Imposed by Emergency and Elective Operations

The problem of decision on the part of the attending physician, the general practitioner, the internist and the surgeon is usually quite easy under emergency circumstances. The emergencies that arise out of trauma, and these are on the increase, constitute clear indications for doing whatever procedures are necessary to maintain life at the minute and hopefully, preservation of an important part of the body, leaving restoration of function to a later time. These objectives are generally accepted even if the patient's condition is precarious. The same attitude prevails on the part of the profession for such diseases as intestinal obstruction, hemorrhage from the gastrointestinal tract, or obstructive jaundice. So far as the patient and his family are concerned, the onset of the condition has usually been abrupt and rapid. The individual has become incapacitated and converted from an active person into one who is disabled. These circumstances influence the patient to have something done as quickly as possible and he is supported in this usually by his immediate family and friends. The sudden onset of disease manifestations that rapidly produce restriction of activities is comparable to accidents that equally disable people, and the reaction on the part of both the profession and patient is to do something about it as quickly as possible.

The matter of elective surgery for chronic and recurrent conditions is an entirely different matter both from the standpoint of the profession and the patient. This parallels the changes that have been occurring since the turn of the century and reflects the increase in experience and knowledge, as well as the progress that has been made. If the physicians involved and the patient know what can be accomplished, there is little reluctance to accept surgery. When the experience of the attending physicians has been poor, when the patient recalls disastrous results from surgery among members of his family and immediate circle of friends, he too is refractory to accepting elective surgery.

The increase in surgery being performed upon the elderly, however, is largely in that category considered of an elective type. There are two conditions that may be cited as examples of this.

First, are operations for cancer in general and of those arising within the gastrointestinal tract in particular. A few decades ago, the demonstration of a malignancy of the distal large bowel in an elderly person, was commonly considered best left alone and not molested surgically until some complication developed that required interference for the preservation of life. This was justified, first, on the basis of the risk associated with the proposed surgical procedure, and second, because of the likelihood of having slow-growing tumors, the elderly had a good chance to live out their expected lifespan. Surgery under these circumstances was undertaken only when there was intestinal obstruction or hemorrhage from the tumor. This attitude has been almost completely reversed. The general consensus now is that tumors in the elderly often can be removed surgically, and the prognosis may be even better than among those in the younger age group. By "staging" many surgical procedures the risk has been markedly reduced. This information is now permeating the laity as well as the medical profession.

Another condition that for some time has been controversial is that of biliary calculi. For the past half century there have been those who have advocated that biliary calculi are best treated conservatively, i.e., nonsurgically, unless they produce symptoms or complications that are unbearable or incompatible with life. Early in that period, the morbidity was high as was the mortality rate for surgery. But as these have been reduced decade by decade, there has developed rather wide acceptance of the surgical removal of the gallbladder containing calculi even though asymptomatic. This has come about because it has been demonstrated that if an individual lives long enough, he will probably have complications which eventually require surgical intervention. The past decades have been marked by controversy, but the continual addition of reported experiences of surgeons and internists has contributed toward acceptance of elective surgery for calculous biliary tract disease as soon as it has been diagnosed. It is likely that this attitude will prevail until preventive measures have been developed to reduce the incidence of the disease in the general population. Indeed, the figures that have been accumulated by insurance companies and hospitals throughout the country demonstrate very clearly that biliary tract dis-

ease is one of the most common causes for urgent or emergent surgery in those over 65 years of age.

There are also many other conditions of similar general nature. Chronic peptic ulcer may deplete the patient because of malnutrition or blood loss. Hernias limit an individual's activity and are a potential threat of intestinal obstruction. Disease of the large blood vessels very insidiously restricts activity.

These are but a few of the conditions that today are shifting from the so-called elective surgery category into that which is considered mandatory. The utilization of prosthetic devices to increase the blood supply to the lower extremity, as well as in the removal of aneurysms, has been one of the most remarkable accomplishments of the past decade. The improvement of the coronary circulation by the introduction of systemic vessels into the myocardium remains controversial but is a stimulus for continual attack upon this disabling condition which is so prevalent among the elderly. The further reduction of the risk of surgery through careful evaluation, and the correction of lesions that formerly have been regarded as contraindications for operative procedures, are resulting in a rapid change in attitude toward surgery.

Extent of Surgery and Technical Considerations

The extent of the surgery indicated surely plays an important role in the decision to reject or undertake it. In general the emergencies that arise in the elderly requiring surgery are often those that can be relieved with fairly simple operations to meet the immediate situation. These include the relief of obstruction for hernia, the decompression of a large bowel for malignancy, and the immobilization of a fracture. All of these procedures can tax the capacity of the elderly individual, but in general they can be accomplished with reasonable ease and safety.

Control of spontaneous hemorrhage is almost always a major undertaking: first, because the majority of major hemorrhages occur within the gastrointestinal tract, and second, because their cause and specific location are often not determinable before beginning the operation. Many major surgical procedures can be accomplished by a step procedure or compromise operation. While these may not be considered ideal by either surgeon or patient, it is remarkable what can be accomplished in relieving an untenable situation. By additional procedures of a definitive nature later, life may be greatly prolonged.

Projected Goals Including the Terminal Patient

In arriving at a decision on whether or not to perform surgery, the surgeon must have clearly in mind the goal that he is aiming for. As mentioned above, the first is the preservation of life, the second is the preservation of the affected part of the body, and the third is the restoration of function. In the elderly and the debilitated, who so often have associated conditions that make any procedure hazardous, it naturally comes about that the simplest procedure possible is usually the one of choice. Once over the first hurdle of removing the threat of death, the next logically follows: to preserve the part, which, in the elderly, is quite frequently impossible. This has to do in particular with the lower extremities, where so often vascular disease, diabetes and infection result in ischemia and ulceration. Although the part may be lost by amputation, restoration of function is fortunately achievable by use of a prosthesis. Rehabilitation of the patient by use of such a device is a part of the surgeon's responsibility. Another example in which life is extended, the part sacrificed and rehabilitation measures essential, is in those with malignancy of the distal large bowel who have to have a permanent colostomy. After resistance and objection to this inconvenience is overcome with proper encouragement and instruction, adaption can be accomplished.

Great progress has been made in many circumstances that have required development of, and instruction in the use of devices such as colostomy bags and suitable extremity prostheses. Continual effort on the patient's part is always essential to overcome his handicap. The projected goals for the patient who has a good life expectancy is a challenge that is also being well met by various paramedical services.

The problem of the patient who is destined to the terminal phase of a disease, however, is indeed a difficult one. Among the aged there are many conditions that are irreversible and indeed irretrievable. Vascular disease that involves the coronary circulation or that of the brain are examples for which surgical attacks thus far have been feeble and not as productive as a few years ago they were considered to be. Extensive cancer in individuals has been attacked most vigorously with radiation chemotherapy and hormonal treatment, including extracts of the endocrine glands. In individual instances, there has been offered some alleviation in terminal phases of malignancy, but in general they remain unpredictable. An attitude that

supports the use of measures that may extend life and alleviate suffering is commendable, but when these become ineffectual and death is imminent, and when procedures inflict pain and suffering that cannot be controlled, then good judgment should result in a decision to stop measures that merely sustain life. A patient confronted with extensive metastatic tumor, experiencing pain that requires large amounts of narcotics that cause him to be disturbed and uncomfortable, should not be required to accept such measures. Inasmuch as these individuals can seldom make their own decisions, it becomes the responsibility of the attending member of the medical profession to exercise judgment, based on the golden rule of doing for his patient what he would want done for himself, were he in that position.

PREOPERATIVE MANAGEMENT

Once the decision has been made to operate upon an elderly patient, it is the responsibility of the surgeon to indoctrinate him as a member of the therapeutic team. How much the patient should be told about the lesion which requires surgery will vary from one to another, and usually the details of pathology or the techniques involved are inappropriate in such a discussion. However, it is of great importance to explain to the patient what he may anticipate in the way of procedures and what is expected of him in accepting and cooperating with the other members of the therapeutic team. Such conversation does two things: first, it gives the patient an understanding of what he should do; second, it removes the disturbing aura that he is being considered as a hospital "number" and that he has lost his individual identity.

Specifically the instructions that are given include what he will experience in being anesthetized, how he will awake in the recovery room and the discomfort that he may then experience. Deep breathing and movement of the extremities are described to him as being of great advantage to his immediate well-being. He must get rid of the anesthetic agent which has, in a sense, been an overwhelming intoxication by inhalation, and the best way to free himself of it is to breathe deeply. He should be reassured that the pain will be held within his capacity to tolerate it by medication, but that medication will be used cautiously so that his vital processes will not be depressed. If a nasogastric tube is to be used, the purposes of it are explained, emphasizing that by keeping the stomach empty, nausea and possibly vomiting can be greatly diminished. Urination in the postoperative period, often a problem in the aged male patient, can be facilitated by having him use the urinal in bed prior to operation.

A careful description of early mobilization with an explanation as to why it is desirable, can be given in terms that the patient can understand. This is usually readily accomplished by pointing out how the circulation can be increased in the lower extremities by standing at the bedside and that the diaphragm can be better mobilized by breathing in this position. If a specific assignment is given the patient preoperatively and he enters into the undertaking with a feeling of participation on his part and a good relationship with his fellow team members, it will give him confidence to withstand some of the burden that, prior to the operation, is usually better appreciated by the surgeon than by the patient. The possibility of complications pertinent to the situation should be mentioned and what steps are employed to prevent them, as well as to meet them, should they occur. This is of particular value in anticipating pulmonary complications.

In the majority of patients for whom it has been decided that operation should be embarked upon, they will have been well screened by a careful history, physical examination and evaluation of all systems.

The elderly patient is frequently malnourished. Complete evaluation of circulating blood, including its volume, provides information indicative of his depletion or reserve. In individuals who have been unable to take fluid and food by mouth, as well as those suffering from many gastrointestinal disorders, fluid and electrolyte imbalance are often present. Their measurement and correction are relatively easily accomplished. They should be meticulously managed, not only to provide for ordinary requirements, but to prevent overloading the circulation, thus adding an unnecessary burden to the heart. Loss of muscle or lean body mass in the elderly, as mentioned above, is not infrequent. Its actual correction is seldom attainable. The patient's protection is usually best achieved through restoration of deficiencies in the circulating blood, including its volume as well as constituents in both formed and fluid elements.

The cardiovascular system in the elderly is often abnormal due to pathological changes associated with aging. Atherosclerosis tends to diminish the lumen of the vessels it involves and restricts blood flow. Impaired circulation to the myocardium requires that all

measures that can possibly contribute to improving it be invoked, when an operation is anticipated. Perhaps between one and two of every three patients seen in this age group will have hypertensive cardiovascular heart disease, peripheral arteriosclerosis, or some combination of the two which will have a bearing upon any surgical procedure embarked upon.

Pulmonary function over the past two decades has received increasing attention in evaluating the elderly individual. Pulmonary arteriolar sclerosis, emphysema and pulmonary hypertension are three conditions that are commonly encountered. An evaluation of pulmonary function indicates specific preoperative preparation where infection plays a role. Diminished pulmonary function can be in part compensated for by the judicious use of respiratory mechanisms. The individuals with cardiac disease and vascular involvement of the pulmonary bed require monitoring with an indwelling catheter to determine central venous pressure. The instruction of the patient prior to operation in breathing exercises and in raising accumulated secretions within the trachea, with or without assistance, is frequently of great help in the postoperative period.

Renal function, like all other critical processes of the body, requires evaluation prior to operation. There are three aspects commonly requiring specific adjudication. One is the capacity of the circulatory system, the second is the degree of obstruction to the urinary outflow distal to the kidney, and the third is the extent of parenchymal renal disease with or without associated infection. Sophisticated methods of evaluating the renal circulation are available for individuals with generalized or localized vascular disease. This, together with a reasonable estimate of impairment of renal function, forewarns the surgeon so that suitable measures may be utilized in an effort to prevent renal failure. Urinary obstruction distal to the kidney is readily demonstrated by ordinary examinations, including evaluation of the prostate, determination of residual urine in the bladder and intravenous pyelography. A combination of vascular disturbance and urinary obstruction increases the possibility of consequences if infection or parenchymal kidney disease is present. Because renal function is related to maintenance of blood pressure during and after operation, the surgeon is alerted to exercise special means to keep it above a critical level by evaluation of the urinary system prior to surgery.

The wide use of steroids in the treatment of arthritis and other conditions commonly seen in the elderly predisposes surgical patients to serious complications. It is desirable to discontinue steroid therapy gradually in preparation for elective surgery. In individuals who require urgent or emergent procedures, steroid therapy is maintained and the possible complications carefully watched for. Because ulceration of the gastrointestinal tract and particularly of the distal stomach and duodenum may result in severe hemorrhage and perforation, this should be specifically watched for. Indeed the patient who has been on steroid therapy and subjected to "stress" at any age, not excepting the elderly, may develop stress ulcer of a devastating nature. Patients who have been on prolonged steroid therapy should be maintained on an ulcer diet and in selected instances, antacids and anticholinergic drugs in an effort to reduce the probability of ulceration of this segment of the gastrointestinal tract.

The overall policy in the preoperative management of patients in this age group is one of meticulous evaluation, leaving nothing to doubt when it can be actually substantiated. Having established a deficiency, every effort should be made to correct it; and failing to accomplish this, every other means to compensate for it must be used. Only by careful preoperative management can the capacity of the patient to withstand the burden of operation be reasonably supported. Successful surgical therapy depends so much upon keeping the surgical burden within the capacity of the patient that it becomes mandatory to continually reevaluate patients who are under prolonged preparation for operation.

It is also to be kept in mind that the reaction to unfavorable circumstances such as infection, anemia and hypotension may quickly develop to serious proportions in the elderly. For example, the response to infection in the elderly may be minimal as compared to the youthful and robust individual who develops a fever, significant leucocytosis and local manifestations of tenderness and pain such as is seen in acute appendicitis. The elderly patient may develop an acute appendicitis that goes on to abscess formation without manifesting pain or systemic reaction. This emphasizes the necessity for complete and repeated examination of the elderly patient during the preoperative period.

It also should be emphasized that some diagnostic procedures in the elderly are associated with considerable hazard that is not present in the younger age group. Freeing of multiple mural emboli or calcified atherosclerotic plaques can indeed be precipitated by the introduction of catheters into the vascular system

for the purpose of visualization. Preoperative measures of decompressing the gastrointestinal tract by nasogastric indwelling tube, well tolerated by the robust, can result in erosion and perforation of the esophagus in those of the older age group. It can also contribute to the patient's inability to raise accumulations of bronchial secretions, predisposing to atelectasis and pneumonia.

Thus in our enthusiasm to evaluate patients in the preoperative period, we must be continually on guard to protect him from the complications that these measures may precipitate. Complaints registered against diagnostic procedures and other objections raised by patients in this age group are usually of more significance than in younger age groups. They are too often looked upon as being a response to being disturbed. The surgeon who pays no attention to these complaints and objections is likely to be caught unaware of a complication before surgery is embarked upon.

THE OPERATION

In the course of providing surgical therapy for any group, and those among the elderly are no exception, the operation is the incident that represents the peak of interest and activity, even though that which precedes and follows it may actually be of greater importance. Certainly what is done at the time of operation very frequently determines to a degree what occurs thereafter. Any operation is a team effort. Many individuals are involved. The two central figures of any operative team are the surgeon and the anesthesiologist who are interdependent. The surgeon's efforts are to be utilized with maximum freedom from interruptions to the procedure that he is performing. The anesthesiologist must be the clinical physiologist and pharmacologist whose skills are used to maintain respiration and circulation in order to insure the metabolic processes so essential to survival and recovery. The smooth operation of the surgical team arises from mutual confidence between the surgeon and the anesthesiologist. As with any team there must be a chief, and the surgeon rightfully has that function at the operating table. However, he must delegate certain responsibilities to the anesthesiologist who is working with him. It is their common objective to maintain a low morbidity and mortality in providing benefits from the procedure that they are mutually carrying out with the maximum degree of cooperation.

The elderly patient presents a challenge to the surgical team through the very nature of the physical deterioration of body tissues associated with the aging process. The chronological age of the patient, however, may be entirely different from the physiological age of tissues and systems. The majority of the elderly have defects in the pulmonary and circulatory systems, and the selection of anesthesia must take these two systems into consideration in particular. The choice of the anesthetic agent and the technique to be employed is primarily the responsibility of the anesthesiologist. The lighter the plane of anesthesia that is compatible with the surgical requirements of the operation, the more favorable is the situation for the patient, regardless of the anesthetic agent used. Unfortunately, almost every agent in use today for general anesthesia reduces cardiac output, and the more profound the anesthesia, the greater is the decrease. The lowered cardiac output is the result of lessened force of contraction of the myocardium and dilatation of the peripheral vascular bed. Light anesthesia minimizes these reactions and contributes to the elderly patient's capacity to withstand the operative procedure. Along with this light plane of anesthesia, it is mandatory that there be adequate oxygenation. Paralleling this is the equal necessity that carbon dioxide be removed. The recognition of deviations in these and their immediate correction, as well as anticipation of the response to additional burdens, require the close cooperation and understanding of the anesthesiologist and the surgeon.

With the patient anesthetized, the surgical team protects the interest of the patient by the expeditious accomplishment of the procedure. The position on the operating table is an important first detail. It should be compatible with the physical tolerance of the patient and insure optimum respiratory and circulatory function. Positions desired to facilitate the operation for the convenience of the surgeon require modification, so that these two vital processes will not be interfered with. The anesthesiologist observes the changes that occur and therefore, by continuously reporting them, enables the surgeon to interrupt trends before irreversible situations become established.

The duration of the surgical procedure assumes great importance in the old-age group. It should never be unduly prolonged. This, however, does not mean that anything but meticulous care should be exercised by the surgeon in every situation, nor should it be allowed to curtail completeness or thoroughness. While no time limits can be set, the review of a large number of hospital records are evidence that procedures up to

three hours are generally well tolerated, and that beyond this, deterioration is frequent despite numerous measures commonly exercised to prevent such trends.

More frequently among the elderly than all others, conditions may occur that render mandatory curtailment of the procedure. An unexplained fall in blood pressure, tachycardia, electrocardiographic changes suggestive of myocardial ischemia, and changes in the encephalogram are examples of conditions that, regardless of whether or not they were anticipated, are indications to curtail, if not stop, the surgical procedure. Under such circumstances a compromise procedure may be lifesaving. An example is seen in the elderly patient with acute cholecystitis in whom it may have been planned to do a cholecystectomy and/or common duct exploration. Deterioration soon after the beginning of the operation may constitute an indication to do a cholecystostomy which will both prevent the possibility of perforation of the gallbladder and hopefully decompress the common duct.

The gentle surgeon and the cautious anesthesiologist, in close cooperation and in continual communication and consultation as the operation proceeds, can accomplish remarkable goals in very adverse situations. Rough handling of tissue increases reflex activity which, in turn, requires more anesthesia in order to obtain adequate exposure. The surgeon's assistants, utilizing available facilities to a maximum degree, materially aid in conservation of time in accomplishing the objectives of the procedure.

Unexpected conditions are frequently encountered among the elderly, particularly in intra-abdominal operations. While the avoidance of unnecessary distortion and retraction and manipulation of tissue is to be guarded against, it is of even greater importance that when an abdomen is open, a thorough and complete search and examination beyond the obvious, be done. This should be accomplished without exception before embarking upon the specific procedure, be it a gastric resection, a cholecystectomy or the excision of a mesenteric tumor. In the aged, the vascular system is frequently the site of aneurysms and atherosclerotic changes that narrow the lumen of the vessel. An unexpected finding may actually be of more vital concern than the condition for which the operation was undertaken. Whether or not to abandon the former and embark upon the latter is a matter that only the surgeon can decide. Particularly in the older person, the evaluation of other than the obvious lesion and consideration of possible sources of postoperative complications is always present.

In many of the elderly, adhesion from former operations or preexisting pathological processes are often found. Whether or not these should be corrected, is again a matter for the surgeon to decide in view of the procedure that he is going to do.

The high incidence of gallstones makes the finding of a gallbladder filled with calculi common amongst the elderly. The question arises as to what should be done when acute obstructive cholecystitis occurs as a complication following an unrelated surgical procedure. Some surgeons prefer to remove the gallbladder, others will do a cholecystostomy, and still others will elect to leave it alone. This, also, is a matter of surgical judgment.

Another condition frequently found in the elderly is diverticulosis of the colon with varying degrees of diverticulitis. Large hiatal hernia, distended urinary bladder due to an obstructing prostate in men, and tumors of the pelvic organs in women are so common that their presence or absence should always be determined. These are some of the conditions that may be unexpectedly encountered and require careful evaluation, with particular attention to the relationship the condition may have to the anticipated postoperative course of the patient.

The finding of extension of a tumor from the large bowel in the elderly patient may be cause for simple excision without node dissection, accepting at the time a palliative operative procedure in place of an attempted curative one.

Peptic ulcer is another example in which the probabilities of the postoperative course require consideration as to what is to be done at the operation. A bleeding duodenal ulcer in an elderly person may continue to bleed after ligation of the eroded vessel, or after a vagotomy and drainage operation. Many surgeons prefer to do a more extensive procedure that will include resection of the duodenal segment containing the ulcer.

In biliary tract surgery the incidence of common duct calculi is so high in the elderly that operative cholangiography and common duct exploration, even though they add to the burden of the operative procedure, may be considered an integral part of it.

The limited capacity of the elderly patient calls for the establishment of certain safety measures to protect him in the postoperative period. Utilization of a transabdominal gastrostomy rather than an indwelling na-

sogastric tube is an example. Resection with restoration of continuity of the large bowel, protected by a cecostomy, is another. Intestinal obstruction, due to metastatic disease, multiple adhesions, certain granulomatous diseases etc. can be given some extra protection in the postoperative period with the use of an enterostomy tube drainage. Tracheostomy is sometimes clearly indicated during an operative procedure upon the neck or the thorax. The combined opinions of the anesthesiologist and the surgeon when they discuss the possible complications at the conclusion of the operation, usually result in the proper decision. Such discussion can be a lifesaving procedure and too often is neglected or utilized too late.

The closure of wounds, including abdominal incisions, in the elderly can be so fashioned that early mobilization can be started without hesitation. The closure utilized should be the one that offers the individual patient the greatest protection against disruption in the postoperative period. At the end of the wound closure on the operating table, evacuation of all accumulated secretions in the trachea or respiratory tract should be complete and doubly checked by the anesthesiologist. Transfer of the elderly patient from the operating table to a bed, if it involves a change in position, is best accomplished slowly and with great care, observing any effect upon blood pressure and evidence of inadequate oxygenation. Wound dressing should be adequate and comfortable and minimal enough to reveal any evidence of hemorrhage, drainage or dehiscence. Drains should be secured to the skin and so incorporated in the dressing that their lumen will not be obstructed.

Upon return to the recovery room from the operating room, observations should be continuous and *not intermittent.* In addition to the usual observations, an indwelling vascular catheter enables one to monitor the central venous pressure. This is most useful and should be employed without hesitation in the elderly patient who has had an extensive surgical procedure. Urinary output is best measured with the aid of an indwelling catheter in both male and female. Respiratory exchange is greatly facilitated by encouragement of the patient to breathe, i.e. to take deep breaths and to move his arms and legs about as early as he is able to respond to a spoken command.

Concomitant with the encouragement to breathe deeply should be reassurance to the patient that all is well. This has a twofold purpose. It establishes his confidence in the surroundings and encourages him to follow the instructions he has received preoperatively. It also serves to reinstate him as an active member of the team and paves the way for early ambulation which is initiated as soon as the patient is completely conscious.

POSTOPERATIVE MANAGEMENT

Immediate Complications

The most efficacious measures of postoperative management consist of preventing, recognizing (when they occur) and promptly treating shock, hemorrhage, pulmonary atelectasis, cardiovascular disturbances, infection and gastrointestinal ileus. These can be prevented in part by preoperative preparation and keeping them in mind from the beginning of the induction of anesthesia to the completion of the operation. The develop ment of most complications are related directly to the narrow margin of reserve of the elderly individual. Precision management is the best method of staying within the limited margins of function compatible with life.

The events in this discussion begin with the return of the patient to the recovery room following completion of the operation. At regular intervals observations are made of pulse, blood pressure and respirations. The patient's position in bed is arranged for maximal respiratory exchange and comfort. For the majority of patients an indwelling catheter affords the best means of observing urine output. For those individuals who have had a prolonged procedure or fluctuating blood pressure during their operation, a central venous catheter is invaluable. For those who have undergone an intrathoracic operation, one or more chest tubes in place to provide drainage and an increase in negative pressure are essential for lung reexpansion. Intra-abdominal operations are frequently an indication for transabdominal gastrostomy. The tube from the stomach is attached, to free drainage. The various operations upon the biliary tract require drains placed in the subhepatic area to prevent accumulations of bile, lymph and blood, a fine culture for bacterial growth. The following complications are considered separately and in the sequence with which they ordinarily appear: (1) shock; (2) hemorrhage; (3) pulmonary atelectasis; (4) vascular complications (cardiac arrhythmias, myocardial infarction, phlebitis, embolism, etc.); (5) infection; (6) gastrointestinal ileus.

Shock

The prevention of shock is best accomplished by maintaining a near-normal blood pressure during the operation. The best method of preventing shock involves the weighing of sponges to determine the blood loss and the accurate replacement of fluids to maintain a satisfactory blood pressure during the operation, along with the continuation of support. The appearance of shock is characterized by fall of blood pressure, an increase in pulse rate, usually an increase in respiratory rate, pallor and a cold clammy skin. Urinary output drops precipitously.

Shock is to be distinguished from reaction to drugs, particularly the narcotics to which an occasional patient is sensitive. This condition will cause a fall of blood pressure but has little effect upon the pulse rate and is not associated with a decrease in urinary output.

One of the best methods of evaluating a patient in whom surgical shock is anticipated is the constant observation of the central venous pressure by means of an indwelling vascular catheter extending into the superior vena cava.

The treatment of shock is usually initiated with the replacement of fluids for decreased circulating volume. Plasma and whole blood[1] are the most effectual. Physiological saline, Ringer's solution, 5 percent glucose in H_2O, dextrose and other fluids that are used routinely for fluid replacement may give some benefit temporarily to the patient in shock but may shortly result in overloading.

The use of vasopressor substances are to be employed in specific situations with care and precision. The ordinary maneuvers of elevation of the foot of the bed, assisted respiration, high intake of oxygen and readjustment of dressings that may restrict respiration or are uncomfortable to the patient, are commonplace measures that are well recognized. In the immediate postoperative period, the development and persistence of shock places upon the surgeon the responsibility of determining whether or not it is due to hemorrhage.

Hemorrhage

The picture of shock is indistinguishable from that of rapid blood loss. The nature and extent of an operation best provides the background for the likelihood of massive hemorrhage and the surgeon is the best judge of the probable sources of bleeding. Extensive procedures of any kind are more likely to be followed by hemorrhage than minor ones. Always to be viewed as suspect of hemorrhage when shock appears are those procedures involving the replacement of segments of large vessels, or intrathoracic procedures, or those in the region of the pelvis such as abdomino-perineal resections. It should be added, however, that hemorrhage can occur following a cholecystectomy from injury to the cystic artery or one inadequately secured during the operation. Surgeons are generally reluctant to admit shock may be due to hemorrhage. Nevertheless, when simple replacement of blood is accompanied by slowing of pulse, restoration of normal blood pressure and slowing of respiration to a regular rate, there is prima facie evidence of bleeding and immediate reoperation is imperative. Anything short of control of the bleeding and complete restoration of blood loss to provide an adequate circulating volume in the older patient predisposes to myocardial ischemia with arrhythmias and possibly cardiac arrest, renal suppression, venous phlebitis and thromboembolism.

Pulmonary Atelectasis

Among the elderly, particularly in males, there is a high incidence of emphysema, as well as a rigid chest wall and varying degrees of atherosclerosis of the pulmonary arterial circulation. These add up to impaired respiratory exchange, so that any further impairment results in inadequate oxygenation. In the immediate postoperative period, perhaps the most common increment to impair respiratory function is the accumulation of increased bronchial secretion which tends to obstruct segments of the bronchial tree. Contributing in this also is the reduced excursion of the diaphragm associated with incision in the abdominal wall. The position of the patient is always important as is the benefit to be gained from frequent position change. The maintenance of an open and free air passage may be difficult but is essential. Assisted respiration by trained personnel, preoperative training in breathing exercises, and the judicious use of suction by a catheter in the posterior nasopharynx and upper larynx provide a most effective combination of measures. Supplementing these is early ambulation.

When a diagnosis of atelectasis is made by physical examination and X-ray, immediate specific measures to encourage coughing and to facilitate deep breathing are very rewarding. Sometimes the removal of a mucous plug by bronchoscopy may be required. Inadequately overcome atelectasis is an indication for instituting chemotherapy.

[1] It is to be kept in mind that blood transfusions add the hazard of viral hepatitis.

Vascular Complications (Cardiac Arrhythmias, Myocardial Infarction, Phlebitis, Embolism, etc.)

The cardiovascular system, so resilient in early life, tends to lose its responsiveness as the aging process proceeds. Contributing and associated with this is frequently hypertension and atherosclerosis, which ranges from minimal change in the arterial wall to complete occlusion of the lumen. The veins, particularly those of the extremities, are frequently dilated and saccular with residual clots from previous phlebitis. Any condition that varies the blood volume in any segment of the circulatory system may be the cause of the specific and serious complication of phlebitis.

Diminished circulation in the myocardium can result in myocardial ischemia, and if the lumen of the vessels are narrowed already, myocardial infarction may occur. If by chance there has been overloading of the circulation, there may be an increase in pressure in the right side of the heart and failure. This too may predispose to myocardial ischemia. When right heart failure and pulmonary edema occur, immediate decompression of the vascular system by the removal of a few hundred cubic centimeters of blood by phlebotomy is indicated. Operations upon the heart, and indeed other intrathoracic procedures, predispose the heart to local irritability, which is an occasional cause of cardiac arrest. Likewise, formed material from diseased valves—as well as thrombi from an area of infarction—may be the cause of arterial occlusion. Occasionally, following operations for malignancy, tumor emboli may be the cause of obstruction in any branch of the aorta. Constant observation of the extremities is required so that evidence of ischemia due to such embolic phenomenon will not be overlooked.

So far as incidence is concerned, phlebitis and emboli from the venous system are by far the most frequent of the vascular complications. Diseased veins, distorted during operation, are prone to be the site of clot formation in the immediate postoperative period. The incidence of these can be reduced by the application of compression stockings on the lower extremities or the wrapping of legs with Ace bandages from ankle to thigh before the operation is begun. Early mobilization, as well as maintenance of adequate blood volume, also does much to prevent them. Patients who have had previous phlebitis, with or without emboli, are probably best managed with anticoagulant therapy instituted some 48 hours after the operation. When most emboli occur postoperatively, anticoagulant therapy may be sufficient, but massive and recurrent embolism is an indication for interruption of the venous return from the lower extremities and pelvis when these areas are believed to be the source. This may be accomplished by complete ligation or partial obstruction by the use of a vena cava clamp. It should be emphasized that preoperative anticipation and utilization of prophylactic measures can do much to prevent the serious postoperative complication of thromboembolism from the venous system.

Infection

Response of the elderly to infection is not always comparable to that of other age groups. The nature of the organism, as well as the extent of its spread, however, is often responsible for infection being fatal to a surgical patient in this age group. The urinary system and the biliary tract are two systems that often harbor gram-negative organisms that may become overwhelming following an operative procedure on them. An intra-abdominal operation associated with soiling of the peritoneal cavity from the gastrointestinal tract, such as is found in suppurative appendicitis, diverticulitis, intestinal obstruction and perforation of the large bowel from malignancy and ischemic necrosis, liberates highly lethal organisms that may be fatal in spite of heroic measures.

Local infection is best controlled by adequate drainage of the source, be this the biliary tract, the urinary tract, or the upper gastrointestinal tract. The use of wide-spectrum antibiotics is usually of value. However, where the organism is known and sensitivity tests have been carried out, a specific antibiotic is by far the more effectual. This is particularly true of those infections encountered in the urinary or biliary tract. Gram-negative septicemia requires immediate, heroic and specific measures to control shock in order to preserve life until the infection is overcome. Wound infection varies little from that found in other age groups as to incidence and treatment.

Gastrointestinal Ileus

Gastrointestinal ileus is most frequently encountered in the elderly following extensive trauma and intra-abdominal operations. Retroperitoneal, as well as intra-abdominal hemorrhage, may be the cause of ileus which ranges from being troublesome to being devastating. Because of a lack of tone, particularly of the musculature of the large bowel, fecal impaction also is frequent in the postoperative period and can be the cause of distention of the large and small intestine proximal to it. Rectal examination is indicated to eval-

uate the distended abdomen of any patient who has sustained trauma or who has undergone an abdominal operation. Like so many of the complications in this age group, their prevention is best initiated in the preoperative period by complete decompression of the gastrointestinal tract and by the confirmation of the presence or absence of abnormalities such as intestinal granulomatous disease, tumors, or diverticulitis. The use of narcotics both prior to operation, as well as in the postoperative period, is also conducive to ileus by reducing peristalsis.

There are several measures that are commonly employed and are very useful in preventing postoperative ileus. The first, of course, is decompression of the upper gastrointestinal tract. While this may be accomplished with an indwelling nasogastric tube, transabdominal gastrostomy which can be accomplished during an abdominal operation, may be preferable for the elderly patient. Individuals who have had a resection of a segment of the large bowel distal to the cecum are materially aided by cecostomy tubes. Occasionally enterostomy is advantageous for individuals who have had to have resection of the small bowel but is frequently ineffective. Although it is desirable to reinstitute alimentation as early as possible after any operative procedure in the elderly, it is to be started with caution. It is a general practice to withhold oral intake until the patient has been able to pass flatus by rectum, receiving thereafter water and clear liquids and gradually progressing slowly to a full diet.

In the elderly, it is important to bear in mind that a distended abdomen in the postoperative period may be due to vascular disturbances. This is, of course, more likely to occur in individuals who have marked atherosclerosis and/or cardiac disease compatible with the liberation of emboli into the general circulation. It is also to be specifically looked for in individuals who have had resection of aneurysms of the aorta. Not only may there be emboli from a suture line as well as from the heart, but also there may be encroachment on the lumen of a mesenteric vessel from injury to the intima during retraction at the time of operation. Fractures of rigid plaques in the wall of a blood vessel may become the source of blood clot formation and either completely obliterate the lumen or liberate a clot that passes into a distal vessel to produce ischemia of a distal segment. Alertness to these possibilities calls for frequently repeated visualization of gas patterns within the gastrointestinal tract by scout films. This, together with local manifestations, may lead to a diagnosis of serious trouble and an indication for exploration.

Drugs

The use of drugs in the immediate postoperative period among the elderly requires critical judgment and great understanding. Depression of respiration may occur even with modest amounts of narcotics. Small doses, therefore, are best employed and, hopefully, intervals between doses extended as quickly as possible. Careful attention to the patient by those in attendance, in doing everything short of the administration of drugs to control pain, is an avenue that promises to reduce further pulmonary complications in this period. The routine use of antibiotics or chemotherapy is to be discouraged, though there is full appreciation that immediate usage of specific chemotherapeutic substances is nothing short of miraculous in its effect upon some of the most devastating organisms.

Nutrition

Adequate nutrition in the immediate postoperative period is more a matter of water and electrolyte balance than the supply of a specific caloric intake. However, the trend of recent years in this endeavor has all too often resulted in overhydration and the complications related to it. In this regard the single most valuable index to be followed is the urinary output. Daily weighing of patients with calculation and meticulous replacement of fluid loss must also be carried out. These practices are adequately detailed in every textbook in surgery. The armamentarium of the surgeon includes also an ability to maintain a proper body sodium and potassium relationship in addition to insuring an adequate urinary excretion. Glucose, 5 percent in water, is probably used more than any other parenteral fluid. However, in the patient who is losing chloride, hypochloremia may occur with its very disturbing manifestations. Therefore, repeated chloride determinations should be done in any individual who is losing gastrointestinal secretions, in particular, bile.

Mobilization

Efforts at mobilization of the elderly surgical patient should be initiated as soon as possible following operation and carried on continuously thereafter insofar as the patient's condition permits. Instruction of the patient prior to operation with practice in getting out of and back into bed has been most effectual. Preoperative review of these measures yields excellent results, for the elderly like to know what is expected of them.

CONDITIONS REQUIRING SPECIAL SURGICAL CONSIDERATIONS

The Acute Abdomen

The most frequent conditions in the elderly associated with an acute abdomen include cholecystitis, appendicitis, diverticulitis, intestinal obstruction, mesenteric thrombosis and massive gastrointestinal hemorrhage. These should be further grouped according to the localizing manifestations that they frequently exhibit, i.e. acute cholecystitis, acute appendicitis and diverticulitis. A gallbladder attack attracts attention to the right upper quadrant, acute appendicitis to the lower abdomen, diverticulitis to the left and lower abdomen. This is somewhat in contrast to intestinal obstruction which usually gives diffuse abdominal pain and can be due to a number of conditions which should be kept in mind. In arriving at a proper conclusion, the differential diagnosis is often aided by X-ray (scout film) examination. Mesenteric thrombosis is one of the more difficult conditions to diagnose among acute abdominal problems in the elderly, and the localization of the site of a massive gastrointestinal hemorrhage is often particularly perplexing.

Acute Cholecystitis

Acute cholecystitis in recent years has come to be the most frequent cause of an acute abdomen amongst the elderly. It is usually a complication of cholelithiasis and chronic cholecystitis. Sometimes, however, it occurs as primary involvement of a gallbladder that contains no calculi. The degree of pathological changes ranges from a mild inflammatory response consisting of hyperemia and edema to ischemia and necrosis of a small area of the gallbladder or the entire organ. Among those patients in the elderly group who develop acute cholecystitis, calculi have often been present in the biliary tract for many, many years, and in women, often dating back to pregnancies in the late teens and early twenties. At the time of an acute illness however, the history is often unsatisfactory.

For most patients with acute cholecystitis, pain followed by nausea and vomiting is the common course of the condition. Pain may be diffuse in the upper abdomen and then localize to the right upper quadrant. Temperature elevation and leucocytosis are variable but often do not parallel the intensity of the process. The complaints and the symptoms associated with acute cholecystitis are usually in proportion to the suddenness and severity of the pathological changes that are taking place. In the debilitated elderly, fever may be absent or minimal. As the inflammatory process increases, the pain becomes more severe and there is spasm of the right rectus muscle. Rebound tenderness in the right upper quadrant and midepigastrium is elicited. In flagrant suppurative cholecystitis, generalized abdominal pain, diffuse tenderness on palpation and increasing rebound tenderness usually indicates perforation with a spreading peritonitis.

An attack of acute cholecystitis may be of short duration, lasting for a few hours or it may persist for days. The longer the duration, the greater is the likelihood of the sequelae of perforation and cholangitis. Indeed, acute cholecystitis associated with common duct calculi may result in an acute suppurative cholangitis. This is characterized by progressive prostration and vascular collapse. It may be followed shortly by death. A virulent bacteremia resulting from ductal obstruction in a biliary tract harboring such pathogenic material as streptococci, colon organisms or staphylococci may be rapidly fatal.

It is to be emphasized that acute cholecystitis is sometimes the first manifestation of malignancy in the gallbladder. In the experience of the author, 18 of 88 patients with carcinoma of the gallbladder were operated upon with a diagnosis of acute cholecystitis, without malignancy having been mentioned in the preoperative evaluation.

There are three approaches to the management of the elderly patient with acute cholecystitis. The first is nonsurgical and consists of bed rest, with or without an indwelling nasogastric tube and broad spectrum antibiotics together with other supportive measures. The second provides for hospitalization and close observation for evidence of progression of the acute process, with the intent that operation will be done should there be evidence of perforation or peritonitis. The third differs from the others in that once the diagnosis has been established, the patient is evaluated with respect to contraindications for surgery and, if these can be overcome, operation is done. This concept provides for operation when the patient is considered by those in attendance to be in the best possible condition. The exact operative procedure to be done is dependent on many factors. The simplest procedure, a cholecystostomy, can be accomplished in many patients under local anesthesia, but ideally the gallbladder should be removed if this is commensurate with the overall situation. However, whenever a gallbladder is removed in an elderly individual, care must be exer-

cised to make sure that there are no stones within the common duct or to take steps to decompress the common duct with an indwelling catheter inserted through the cystic duct remnant.

Acute Appendicitis

Acute appendicitis in the elderly is not always correctly diagnosed. Generally the symptoms are comparable to those in younger people—mainly pain of a generalized abdominal nature localizing to the right lower quadrant and associated with nausea and vomiting. There is usually an elevation of temperature and leucocytosis, but all of these manifestations may be lacking, and it is not unusual to have an appendiceal abscess form and present itself with no other clinical manifestations than the abdominal mass. Certainly any individual of any age with signs of an acute abdomen should have the benefit of acute appendicitis being considered.

Prior to operation, it may be impossible to differentiate acute appendicitis, with or without perforation, from a perforated diverticulitis or malignancy of the large bowel with escape of fecal material into the pelvis. In any event, operation is indicated without delay. Where the diagnosis is well established, the approach through a McBurney's incision will minimize the period of convalescence. Where the diagnosis is not established, a right rectus incision may be employed. Appendiceal abscesses require drainage, not necessarily an appendectomy.

Diverticulitis

Diverticulosis while seldom seen before the forties is present in almost 100 percent of individuals over 80; therefore, those over 65 have a high incidence of the condition. Diverticuli are potential sites for infection and hemorrhage as well as obstruction. Diverticulitis without perforation may be managed well medically in the majority of instances. However, obstruction and perforation, as well as hemorrhage, are complications that occur and are indications for surgical intervention. The acute abdomen in this instance is usually the site of an abscess about a diverticulum or a spreading peritonitis from a free perforation of the descending colon. More often than not, these occur in debilitated patients who are quite ill by the time of admission to the hospital. Local drainage of the abscess in the area of perforation, if there has been a free perforation, combined with a completely diverting proximal colostomy, is the procedure of choice. Definitive surgery should be postponed until the patient can be thoroughly evaluated and such debilitating conditions as may be present have been corrected insofar as possible. In the older age group, primary resection under the circumstances of perforation is contraindicated.

Intestinal Obstruction

Intestinal obstruction which is common in the aged can be the result of hernia, adhesions, neoplasia, diverticulitis, volvulus and other causes. The manifestations are dependent largely upon whether or not it is in the small or large bowel. The higher the site of obstruction, usually the more dramatic is the onset, the more intense is the complaint of pain, and the greater is the degree of nausea and the amount of vomiting. The presence of an abdominal scar which is unmistakable evidence of a previous operation, as well as the patient's history and physical findings, do much to aid one to establish the correct diagnosis. A scout film of the abdomen is also of help in locating the site of obstruction as well as the progress or lack of progress that may follow the institution of conservative measures. Decompression by means of a nasogastric tube supplemented by a Miller-Abbott tube is often successful in relieving the immediate acute situation. Its employment, however, is not without some risk because constriction of a segment of a bowel due to an intra-abdominal band or volvulus may result in ischemia and necrosis of the bowel wall with perforation and peritonitis. Among elderly females, the Richter type of obstruction of the small bowel associated with femoral hernia is not uncommon.

In the presence of an established diagnosis of intestinal obstruction, the safest procedure is surgical exploration, not only to meet whatever situation may exist, but also to guard against the continuation of strangulation with loss of integrity of the bowel wall. The usual measures of supporting such a patient and keeping the operative procedure to a minimum, or rather within the capacity of the patient, is applicable here as in any other indication for surgical treatment of acute intestinal obstruction. Included in intestinal obstruction, of course, is mesenteric thrombosis which fortunately occurs rarely, but in the aged is more frequent than in the younger individual. Arterial infarction from emboli in individuals with heart disease is a comparable entity.

In all instances of intestinal obstruction, fluid and electrolyte depletion has usually occurred by the time of admission to the hospital. The extent of fluid loss has a direct bearing upon the outcome of any elderly

patient with intestinal obstruction. Therefore, emergency evaluation and chemical determination of electrolytes in the plasma and estimation of the patient's circulating volume are essential. Obviously, replacement of fluid and electrolytes is essential in the preoperative, operative and postoperative periods.

Massive Hemorrhage From the Gastrointestinal Tract

The most frequent site for a massive hemorrhage is a peptic ulcer, but it may occur from esophageal varices, submucosal aneurysmal dilatations in any place in the intestinal tract, diverticulitis and malignancy. Massive hemorrhage is particularly serious in elderly patients and the mortality remains high. Myocardial infarction is one of the more common complications of massive hemorrhage and is the result of lowered blood pressure resulting in myocardial ischemia.

Chronic Abdominal Conditions

There are a number of "chronic" conditions within the abdomen that require surgery. Because of their chronicity, however, they can be approached electively, affording adequate preoperative preparation together with an evaluation of the patient's capacity to tolerate the procedure or procedures required to correct them. The four most frequent are: (1) biliary tract disease, (2) cancer, (3) major vessel disease; and (4) diaphragmatic hernia.

Chronic biliary tract disease

Biliary tract disease has been discussed previously in this chapter. On an elective basis and under optimum conditions, the mortality and morbidity associated with surgery is held by many to be less than that associated with complications from the disease. As an illustration, the high incidence of common duct stones in the elderly is often associated with changes in the liver, and the resulting recurrent cholangitis with cirrhosis enhances the possibility of serious complications in the postoperative period. The likelihood of this occurring in older people is greater than in the younger and more robust. To avoid such complications, elective surgery is believed by many to be the only effective approach.

Cancer

Malignancy of the gastrointestinal tract is most frequent in the large bowel in the older age groups but occurs in all age groups. Carcinoma of the stomach has decreased in recent decades. Carcinoma of the biliary tract and pancreas, regardless of the therapy provided, have a poor prognosis. For a long period of time, a life expectancy of two years has been generally accepted for biliary tract carcinoma, with an even more conservative estimate for carcinoma of the pancreas. Thus palliative, rather than attempted definitive procedures, are frequently employed. Carcinoma of the large bowel, however, has a much better prognosis, particularly when it is attacked in an early period before it has spread by perforation of the bowel wall or into the lymphatics or blood stream. Fortunately, staged procedures can be employed for lesions of the large bowel, allowing the surgeon to eventually do an extensive and definitive extirpation that is frequently curative. The problems associated with the type of extensive procedures required are parallel to those that have been discussed previously.

Radiation and chemotherapy have been demonstrated to be of "limited" value as is the case for other age groups. The use for and tolerance of chemotherapeutic substances by elderly people is very debatable because some of these substances are very toxic and the end results unpredictable.

Major Vessel Disease

One of the great surgical contributions of the past few decades has been the approach to aneurysmal dilatation and obliterative major blood vessel disease. Improved methods of diagnosis by visualization with arteriograms and angiograms, and the development of prosthetic devices for replacement have added greatly to the lifespan of those in the elderly group who have advanced vascular disease. All segments of the aorta have been successfully replaced, and in instances where this has been inadvisable, bypass channels composed of synthetic materials have done much to ameliorate symptoms and probably extend the lifespan. The mortality and morbidity of complications depend largely upon the general status of the patient. Because coronary artery disease often accompanies these vascular lesions, the likelihood of myocardial infarction is always present. Renal disease of a vascular nature is another hazard requiring consideration in evaluation of patients in this group, before embarking upon such a major undertaking.

Diaphragmatic Hernia

With advancing years there is a decrease in muscle tone of the body in general and this is sometimes quite marked in the musculature about the hiatus of the diaphragm. There is also the tendency for older people to deposit fat in the mesentery and omentum resulting in an increased volume of abdominal contents. Consti-

pation may be considered another increment by giving rise to periodic enforced increase in intra-abdominal pressure. This combination of increased intra-abdominal contents and pressure and the relaxation and loss of resilience of the crural fibers of the esophageal hiatus results in the stomach being forced through this aperture into the chest.

Esophageal hiatal hernia may lead to a number of symptoms ranging from simple regurgitation of previously eaten foods, to massive hemorrhage. Substernal pain and distress, the result of an esophagitis caused by the regurgitation of acid gastric contents into the segment of the stomach above the diaphragm and into the esophagus, are not frequent. The most serious complication is erosion of the mucosa and ulceration that involves those vessels near the esophagogastric junction resulting in massive hemorrhage. This may require emergency surgery. In general, it can be said that the incidence of recurrence of esophageal hiatal hernia in the elderly is fairly high, chiefly because of the poor musculature of the crural muscles and the sedentary habits of the aged person and other factors which result in a continuation of increased intra-abdominal pressure. Conservative measures should be given a thorough trial before embarking upon surgery.

Trauma

The elderly are just as subject to trauma in the home, on the highway and wherever they may be as are those who are younger. The injuries they sustain often mark the beginning of a series of untoward events that are serious, ending in death or prolonged disability. This is in contrast to younger persons who may make a quick recovery from comparable injuries. Any trauma to an elderly person merits prompt and judicious attention. The general principles of careful detailed evaluation as has been discussed elsewhere provide the basis for its surgical management. However, certain modifications in approach are to be employed when the accident victim is in an elderly age group. The greater the extent of the trauma, the more urgent it is to institute measures of resuscitation and restoration of physiologic derangements.

Traumatic shock is poorly tolerated, and whether established, incipient or anticipated, direct therapeutic measures, such as restoration of blood volume by the administration of appropriate fluid, while guarding against overloading, must be immediately instituted. Hypotension and reduced circulating blood volume predispose to myocardial ischemia and possible cardiac arrest. Fluid overloading in the elderly person, who often has increased resistance in the pulmonary circulation, may easily result in right heart failure. Monitoring of the central venous pressure is a valuable guide in such circumstances.

Falls resulting in fractures of the skull, ribs and femur are examples of accidents of grave import in the home. On the highway, auto accidents result in all gradations of serious injury, those involving the thorax and abdomen ordinarily being among the most difficult to evaluate. Many of those experiencing major and severe trauma are to be salvaged only by undelayed surgical procedures. This requires good judgment and losing no time in unnecessary preparation. The nature and extent of any operation is often limited to the essential objective of preserving life. Thus, the capacity of the patient to withstand the indicated procedure determines what is initially done, and definitive procedures to restore optimum function must be performed later. Even with all the excellent programs being carried on by well-trained surgeons in the emergency rooms throughout the United States, the elderly, injured patient is sometimes lost because of a disregard for detail or by delayed management that would make little difference to the young and robust.

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SECTION B/CLINICAL PROBLEMS CLOSELY RELATED TO MULTIPLE ORGAN SYSTEMS

Part XII/Nutrition

RECOGNITION AND MANAGEMENT OF THE NUTRITION PROBLEMS OF THE ELDERLY

By

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INTRODUCTION

The importance of nutrition in the life of any human being cannot be overestimated. George R. Minot once said, "Man's future will depend very largely upon what he decides to eat." The quality of the remaining life of the elderly individual also depends greatly on what he chooses to eat. The intake of food is one of the greatest variables in man's life and yet, for the adult in a prosperous society where food is readily available, scant attention is paid to it by the medical profession.

Famine, which is defined as general scarcity of food, will not be discussed in this chapter. Rather, the content will be concerned with semistarvation, the inadequate intake of essential nutrients, and the excess intake of food as these occur in the aging population. Examination will be made of the causes of malnutrition and its effects both on the aged person who is otherwise well, and on the aged person who has chronic disease or disabling injury. Finally, a description will be presented of simple practical methods from the authors' experiences and the experience of others, by which malnutrition in this age group may be prevented or corrected.

There is much debate and controversy about the requirements of the aged for calories and essential nutrients. In reviews of the subject, Watkins (1966, 1968) has pointed out that, unlike the approach used for the pediatric population, a general prescription for the aging population cannot be made. Old age does not have nutrition problems capable of unique solution. There is too much individual variation among the aged resulting from the insults of disease during the person's lifetime, variations in body structure and metabolism, and differences in physical activity. Instead of weighing all the evidence in the literature, a different approach will be taken and the principal theme of the treatise will show how the application of the authors' treatment plan should bring about optimum nutrition, or the approach to it, for each individual.

The treatment plan is very simple and consists of two parts:

1. The individual shall consume in natural foods without supplements the National Academy of Sciences —National Research Council's "Recommended Dietary Allowances" (RDA's) (NAS–NRC, 1968) of essential nutrients consisting for the purposes of this presentation, of essential protein, vitamins, and minerals. These can be included in not less than about 1200 calories daily and hereafter will be designated as the Core Foods.

2. The individual's caloric intake will be regulated so that he is at, or approaching his ideal weight, which will be defined later in this chapter.

The author's definition of optimal nutrition therefore is: "A person not having organic disease is optimally nourished if he habitually eats the Core Foods and is at his ideal weight. At any point in time his nutritional status is as good as it can be if he is eating the Core Foods and is approaching his ideal weight." This may seem like a gross oversimplification, but it is hard to deny that this dynamic definition of good or bad nutrition is as good as any other and can be applied to the great majority of aging people and, for that matter, to adults of any age.

ASSESSMENT OF NUTRITIONAL STATUS

The nutritional state of an individual at a given point in time is the net of his intake, absorption and utilization of nutrients. The classification of nutritional state as good or bad depends on the frame of reference. For the aged person, good nutritional state can be defined as a physical and mental state of health that cannot be improved by providing or withholding food. This very general and imprecise definition implies that inadequate intake of nutrients, as represented by the total diet or by specific portions of the diet, can result in a poor nutritional state, as can an excess of nutrients.

Evaluation of the nutritional state of the aged person in the absence of severe malnutrition is difficult (Weir and Houser, 1963). However, such evaluation should be part of the history and physical examination of every patient.

History

Diet History

Information about the recent and current diet is useful both for evaluation of the person's nutritional status, and for future planning of indicated diet changes. The most one can hope for from historical review of diet is a description of patterns or eating, and a feel for kinds and amounts of foods consumed. The often erratic eating patterns of the aged make a 24-hour recall of intake unreliable as an indication of the usual diet of the person. Attempts to reconstruct precise dietary histories beyond the 24 hours are most often unrewarding. Careful questioning of the aged person or of a close relative or friend should permit reconstruction of patterns of eating, particularly change to new patterns, which frequently are ones of great variations in day-to-day intake of calories. Of particular concern are questions concerning the frequency of bakery and snack items. These items, relatively cheap and convenient, frequently are a major source of calories at the expense of protein.

The diet history should also be directed toward getting information about who prepares meals, purchases food, and controls the consumption of food in the household. This latter information is useful as a check on the diet history and is necessary in order to give appropriate advice about the diet.

The diet history should include questions about the intake of vitamin or other nutrient preparations. It has been demonstrated that supplemental vitamin intake usually shows no relation to need as determined by the amounts obtained through foods. (LeBovit, 1965; Witschi et al., 1970.)

Diary recording of diet by the person, himself, or by a spouse or other observer, is a useful technique for getting more precise information about the diet. This method requires a great amount of cooperation and understanding by the person recording the information, if a valid record is to be obtained.

A careful history will usually suffice and, along with other information from the physical and laboratory examinations, will obviate the need for the more detailed diary record.

Other History

Changes for the worse in behavior, mental state, physical activity and endurance, and interpersonal relationships should be sought for in the history. While these changes frequently are associated with the aging process, they may be related to poor nutrition, and with appropriate nutritional management may reverse themselves. Information about physical activity and sleep and time in bed are also important in assessing the caloric requirements for maintenance of desirable weight.

Physical Examination

Weight

Body weight is the most useful single observation for assessment of nutritional status. However, interpretation of an individual's weight relative to his nutritional state presents some difficulties.

The first is the reference against which to evaluate the current weight of the individual. Standard height and weight tables which reflect the average weights of selected populations are useful guides, particularly if desirable weights are based on the average weights for height of the population aged 25 to 29. A table of desirable weights adapted from the Metropolitan Life Insurance Co. tables is presented later in this chapter.

Problems are associated with the definition of frame size from the standpoints both of the population being used to determine the average weights, and the individual being evaluated. If a reliable estimate can be made of an individual's own weight at age 25, this figure is probably the best guide to interpretation of his current weight. With the exception of the increase in muscle mass of those rare individuals who become physically active after age 25, weight gain by persons after this age results from increase in body fat. Weights above

the reference weight should be considered as evidence of overnutrition; weights ten percent or more below the reference weight should be considered as presumptive evidence of undernutrition.

Difficulty in interpretation of weight can also arise when a person is at, or near his desirable weight. This difficulty lies with the changes in body composition associated with aging. As the body ages, there is an increase in fatness, decrease in musculature, and demineralization of bone (Moore et al., 1963; Brozek, 1961). Whether or not these changes are a necessary part of the aging process or reflect changes in nutriture that accompany aging is not clear. Nevertheless, it is possible for a person to be at, or above desirable weight as a result of fat increase when his nutrition is not optimal.

An additional consideration in evaluation of current weight is fluid retention with a relative increase in extracellular fluid as a result of prolonged undernutrition. The retained fluid may not be apparent as edema, but may add sufficient weight and mask soft tissue wasting so that by weight and appearance the person does not appear undernourished.

Body Fatness

Although body weight is a simple and accurate measurement and can be evaluated with reference to a standard, it is a summation of body composition. The proportions of intracellular and extracellular water, lean dry body mass, and body fat represented in the weight are the basic considerations when weight is evaluated. Except for the presence of overt edema, the relative fatness of the individual is the only part of body composition contributing to the weight of the person, that can be readily assessed in the physical examination.

It is therefore important to obtain some estimate of fatness in order to determine the significance of relative body weight. Good correlation exists between the thickness of skinfolds (for example, over the triceps, subscapular, and lateral abdominal wall) and relative body weight.

Although it may be extremely difficult to predict fatness from relative body weight because of frame size and physical activity variables, visual inspection of the patient and measurement of skinfolds, either with calipers or by pinching between thumb and forefingers, can give useful information on which to interpret the meaning of relative weight in terms of lean body mass and fatness. Skin fold calipers are simple to use, relatively inexpensive, and provide quantitative data concerning the individual's fatness, both in relation to population figures and to the individual's own status from time to time.

If weight at age 25 is considered the desirable weight for the individual at any subsequent age, any increase in weight apart from water retention must be attributable to fatness which should be apparent from inspection and skinfold thickness estimation. Conversely, when the individual weighs less than he did at age 25, this condition, if not due to loss in lean body mass, should be accompanied by very little fat in the skinfolds.

Physical Signs of Nutritional Deficiency

Certain changes of the skin and mucous membranes are associated with deficiencies of nutrients, either singly or in combination. The physical signs resulting from these changes are not pathognomonic of deficiency, however, since they may be present in the absence of demonstrable deficiency. When signs are present they should alert the physician to consider nutrient deficiency in his differential diagnosis.

Glossitis is a not uncommon complaint and finding in the aged. The red, painful, fissured tongue with atrophy of the filiform papillae can result from B group vitamin deficiency, but other causes such as irritants, systemic antibiotics, and uremia must be considered. A pale atrophic tongue may be related to anemia which can be either nutritional or nonnutritional.

Another frequent finding in the aged is breaking of the skin at the corners of the mouth with maceration and fissuring. This sign has been associated with deficiency of niacin, riboflavin, or pyridoxine but also may result from poorly fitting dentures. Wearing of dentures, poor oral hygiene, or periodontal disease may also result in changes in the tongue and gums that cannot be distinguished from changes resulting from specific B vitamin lack.

Dryness and pigmentation of the skin, increased thickness of the skin over pressure points, follicular hyperkeratosis, and nasolabial seborrhea are signs that may be associated with deficiencies and should be investigated. Thickening and opaqueness of the bulbar conjunctivae is a frequent finding in the aged. Again the presence of this finding should lead one to consider a possible nutritional etiology, particularly vitamin A lack.

Other physical findings such as liver enlargement,

parotid gland enlargement, calf tenderness, loss of vibratory sense, absent tendon reflexes and petechiae and ecchymoses should arouse suspicion of a possible nutritional etiology. Symmetrical hyperemia and dry cracking lesions of the skin of the hands or other areas exposed to the sun should raise the question of pellagra.

Laboratory Examination

Relatively simple and routine laboratory tests can be very helpful in assessment of the nutritional state. These tests are measurement of the hemoglobin concentration, the hematocrit, and the serum albumin concentration.

Studies of aged persons have suggested that reductions of hematocrit and of hemoglobin concentration are a normal part of the aging process (Wintrobe, 1967). There is evidence, however, that well-nourished older persons have hemoglobin values in the range considered as normal for younger adults (Libow, 1963), and that the low values in certain groups of older persons may well be due to malnutrition (Wintrobe, 1967). Hematocrits below 40 in the male and below 38 in the female should not be accepted as normal for aged persons without consideration of dietary iron or protein deficiency, as well as blood loss or specific diseases associated with anemia.

Specifically related to diet are the microcytic anemias of iron or pyridoxine lack and the macrocytic anemias of folate and B_{12} lack. Anemia in the aged may be associated with protein calorie undernutrition without evidence of specific deficiency of iron or vitamins (Weir, et al., to be published). Hemoglobin concentrations at or below accepted lower ranges of normal should not be dismissed as related to aging unless a possible nutritional etiology, as well as other specific etiologies, are considered. When specific diseases are present, such as kidney disease with moderate elevation of the blood urea nitrogen or persistent low-grade infection, one should not attribute an accompanying anemia to these diseases without consideration of the possible contribution of poor nutrition to the anemia.

The serum albumin concentration is not generally considered a sensitive indicator of protein nutrition. Relatively severe protein deprivation must occur before the level of serum albumin is sufficiently low to result in edema. However, serum albumin does tend to decrease with marginal protein deprivation (Brock, 1966). Serum albumin levels below 3.5 grams per 100 ml should be considered as below normal and indicate reduced intake or utilization of protein or protein losses. Concentrations below 3 gm/100 ml have been associated with anemia presumed to be caused by inadequate protein in the diet (Weir et al., 1969 to be published).

Determination of total serum protein concentration or the A/G ratio is not helpful. Serum globulin levels may increase with reduction of serum albumin and a total serum protein concentration within the normal range may result. Likewise, a reduction in serum globulin with reduced serum albumin can result in an A/G ratio within the normal range.

Measurement of serum and blood levels of various vitamins and of the excretion of vitamins in the urine, either related to creatinine excretion or following loading tests, is possible in some laboratories. Where results are below certain ranges for each of the vitamins, a diagnosis of specific deficiency can be supported. In general, interpretation of the significance of the results of serum or blood vitamin levels and urine excretion is difficult in the individual subject. The physical findings and history should be consistent with the laboratory findings before a diagnosis of deficiency is accepted. Determinations of serum iron levels and serum iron binding capacity, of course, are extremely useful in establishing the etiology of anemia.

Consideration of overnutrition from the laboratory standpoint essentially rests on the determination of the lipid concentration in the serum. Elevation of the cholesterol level and hypertriglyceridemia are indications for serum lipid electrophoresis in order to characterize those hyperlipidemias amenable to dietary control.

CAUSES OF MALNUTRITION

Space does not permit discussion of the pathogenesis of malnutrition which is due primarily to specific disease of the gastrointestinal tract, metabolic disorders such as hyperthyroidism, metastatic malignancy, or irreversible damage to the liver, kidneys or pancreas. This discussion will deal only with the malnutrition resulting from circumstances which bring about inadequate or excess intake of food in the aged well person, or the person who has chronic disease or disability other than those listed above, such as major fractures or central nervous system disease or injury.

Even in a prosperous country such as the United States, semistarvation due to lack of money to buy food is not uncommon. This factor should not be over-

looked even if the person denies it through pride or self-consciousness.

If adequate food is available and there are no absorptive or utilization problems, the causes of malnutrition may be put into three principal categories:

1. Rejection of food with inadequate calorie intake.
2. Unbalanced intake with adequate calories.
3. Excess intake.

Rejection of Food

The older person who rejects food is usually underweight and may have a variety of symptoms and signs of undernutrition. As discussed above, these manifestations may be those of "senility" and/or mental dullness, apathy, withdrawal, muscular weakness, objective changes in the skin and mucous membranes, anemia, low serum albumin, low blood vitamin levels, and other findings. The overall performance of the individual is usually suboptimal. This is a common occurrence in the aging population, particularly in those with chronic disease or disabling injury.

Reasons for the rejection of food may be obvious, such as lack of teeth, or they may be obscure. Sometimes the old person is living alone, will not bother to obtain or cook the proper foods and has no social stimulus to do so. For some, rejection of food is their reaction to loss of status, perhaps due to retirement, or to a feeling that they are no longer needed or wanted in the community or the family circle. It can be an expression of hostility toward the entire world and toward the people around them in particular, and it can be used as a weapon to manifest anger, resentment, and rejection of family. In severe form it can be viewed as a passive suicidal intention.

A wealthy 78-year-old surgeon in good health but somewhat infirm was finally persuaded to give up his practice. He promptly began rejecting the high quality food which was made readily available to him by a devoted wife and servants. Gradual weight loss set in, he lost interest in his hobbies and in reading, became more and more withdrawn, and finally retired to his bed where he became incontinent and required constant nursing care. Aside from compensated cardiac disease, his physician could not find significant organic disease to account for the malnutrition.

This syndrome has been called the "Malnutrition of Affluence." Although all efforts were unsuccessful with this case, experience with many others has shown that, if proper realimentation can be accomplished, the situation can be reversed.

Few aged persons reject all foods as did the subject described above. Rejection may be selective as has been observed by the authors under hospital and nursing home conditions, though it was recognized that these observations took place under circumstances not entirely comparable to the home situation.

Chosen for observation were a group of seriously underweight patients, having conditions such as hip fracture, who were able to chew, swallow, and digest a normal diet. They were offered an 1800-calorie 85-gram protein diet adequate in all nutrients, and for a week or more their intake was determined without their knowledge by the weigh-back method. A few immediately began eating all the food offered, but for others a significant pattern of food consumption emerged. Calorie consumption amounted to only 900 or less of the 1800 offered, and consumption of protein amounted to only 10–30 grams of the 85 grams offered.

It is believed that this selective rejection of high quality protein with its essential nutrients, when continued over long periods of time, must have a profound effect on the nutritional status of the individual.

Unbalanced Intake With Adequate Calories

Maintenance of ideal body weight in no way rules out malnutrition. As described in the previous section, the selective rejection of meats and other nutrient-bearing foods may occur, but is balanced calorically by increased intake of "empty" or "naked" calories, i.e., refined flour, refined fats, sugar, and alcohol. Alcoholic cirrhosis of the liver and pellagra are extreme examples of this. In the older age group, the symptoms and signs described in the previous section are common.

Many older people who become less active have decreasing caloric needs and appetite; and again, high-quality protein may be rejected first. They may develop a preference for prepacked or easily consumable foods such as crackers, pastries, and bagged snack food, and in this way maintain their body weight. Modern food technology makes such foods readily available and at low cost. Older people who eat alone or have difficulty in preparing foods may turn to this source of calories.

Some workers maintain that food fortification programs and the giving of supplements of vitamins and minerals should prevent or cure this form of malnutrition. It is quite evident however, that these methods do not provide high-quality protein. Also it has frequently

been pointed out by several observers that unknown essential nutrients undoubtedly exist in food and these are not supplied by artificial methods. It is logical to assume that the unknown essential nutrients will accompany the known ones, and that a diet containing the RDA's of the known nutrients will provide adequate amounts of those that are unknown.

Excess Intake

The overweight or even obese person may have the same nutritional imbalance described in the previous section for the person of normal weight. This results from the excessive intake of "naked" calories along with the rejection of high-quality foods.

Because of its prevalence, simple obesity without deficiency of essential nutrients is considered a most important problem. Indeed some have described this as the most important single medical problem in the Nation today.

This discussion is not the place to review the facts showing that obesity shortens life, increases the severity of certain diseases, and increases the disability, with reduction of the rehabilitation potential of older persons having major fractures, strokes, and other such conditions. The evidence for these is accepted, and furthermore it seems safe to state without fear of contradiction, that there are no scientific facts to show that any physical benefits are to be derived from being overweight. Overeating, overdrinking and oversmoking are all the same, in that they do no physical good and can do harm.

For the vast majority of obese people, the causes are simple: food is readily available; they enjoy eating; they often lead sedentary lives. In certain societies, obesity is considered a status symbol in that it is equated with prosperity and is therefore deliberately acquired. In our society this is uncommon. Most people who become obese do so because they simply refuse to forego the pleasures of overeating. They ignore or don't care about the penalties involved and often cannot even be persuaded that there are any penalties. They don't care about the loss of physical attractiveness imposed by obesity or the limitation on mobility. The pleasures derived from eating completely submerge any incentives to lose weight.

Obesity can be, and often is associated with emotional disturbances and not infrequently with severe neurosis. It is important for the physician to recognize and assess the severity of the emotional disturbance as a contributory or causative factor.

Much has been written about inherited or familial predisposition to obesity. The best evidence (Gordon, 1964; Pollack et al., 1958; Bloom and Marshall, 1967) seems to indicate that if such predisposition exists, the important factors seem to be a combination of normal variation in basal metabolic requirements for calories and variation in the amount of voluntary muscle activity while at rest. Some people can never sit still and constantly make small muscular movements, thus expending considerable muscular energy even without walking or otherwise formally exercising. Such an individual would not gain weight on a caloric intake which would cause obesity in a person whose muscles are completely relaxed when resting. Obviously the control of obesity for the latter person is more difficult because the caloric restriction must be greater. In any case there is little or no evidence to show that, for the vast majority of obese persons, weight loss cannot be accomplished by simple caloric restriction.

A second factor influencing the expenditure of energy by voluntary muscles, and one that is often overlooked, is the amount of sleep a person seems to require or actually gets. It can easily vary from 6 to 10 of the 24 hours. On the average, the person who is up and about for the extra 4 hours is burning more calories and is obviously less apt to gain weight.

Exercise, the third factor involving expenditure of energy by voluntary muscles, usually is taken into account and is often prescribed as a therapeutic measure to reduce weight.

Gordon (1964) has reviewed the evidence on so-called resistant obesity, hereditary obesity, and biochemical differences in the obese. He concludes that: "reduction of caloric intake below output over a long period *must* result in weight loss."

In discussing the causes of malnutrition in the aged and chronically ill, a final word should be said about habit and the time factor. Habit is defined as a practice established by constant repetition over a period of time. The longer the practice has gone on, the more deeply ingrained it becomes in the very personality of the individual and the more difficult it is to modify. Therefore modification of the habitual diet can be much more difficult for the older person than for the younger person.

THERAPY OF MALNUTRITION

As already stated, in the experience of the authors the 2 fundamental therapeutic goals for all malnourished patients are:

1. An intake of natural foods in the amounts needed to provide the essential nutrients, including high-quality protein, at least at the minimum levels to meet the RDA's.

2. An intake of sufficient calories to be at, or approaching ideal weight.

General Principles

In order to meet the first goal, the minimum frequency and amounts of the foods listed in Table 1 must be eaten daily. These have been termed the Core Foods. The energy value of the Core Foods as listed is approximately 1,200 calories. The Core Foods are arranged in the food group patterns of the American Dietetic Association and the American Diabetic Association Food Exchange Lists (ADA, 1950). The frequency of the daily intake of items within each food group is consistent with the "Basic Four Food Groups" dietary pattern (Institute of Home Economics, 1958). Variety in choice of meats and vegetables should follow the basic four food group recommendations to insure adequate intake of thiamine, vitamin A, and calcium.

Table 1.—The Core Foods

[Daily requirements—1,200 calories]

Food group	Amount to use daily [1]	Total calories	Number of A.D.A. exchanges
Breads:			
Bread or toast (whole wheat)	2 slices	140	2
Cereal (whole grain or enriched):			
Cooked	½ cup	70	1
Ready-to-eat	¾ cup		
Potatoes or substitute (white):			
Baked or boiled	1 medium	70	1
Mashed	½ cup		
Fruits (not sweetened):			
Citrus—orange, grapefruit, etc	¾ cup	60	1½
Other—preferably fresh:			
Whole	1 medium	40	1
Cut (sliced, diced, etc.)	⅓ to ½ cup		
Meats and meat exchanges:			
Egg:			
Shell cooked or poached	1 "large"	75	1
Scrambled	¼ cup		
Meat, fish, fowl (lean, flesh only, cooked)	5 ounces [1]	375	5
Milk: Whole (3.5 to 4% butterfat)	2 cups (1 pint)	340	2
Vegetable (1 serving per day):			
"A" Vegetable. Spinach, lettuce, snap beans, cabbage family, tomatoes, summer squashes, cucumber.[2]	1 cup	35	1
"B" Vegetable. Peas, lima beans, winter squash, root vegetables.[2]	½ cup		
Total caloric value (per day)		1,205	

[1] Standard measuring cups clearly marked to show fractional amounts and weighing scales for the meat are to be used in the beginning. The person will soon learn to measure accurately enough by eye so that he can serve himself with a serving spoon or fork.

[2] More complete lists can be obtained from standard texts.

In general the Core Food plan allows considerable variation of the items within each basic food group, but permits no changes with respect to the food groups used or the minimum amounts required. Due to differences in the nutrient composition, no one food group can be substituted for another even though the caloric value may be fairly comparable. Techniques inherent to the A.D.A. system may be used to make exchanges such as cheese for rejected milk, more meat for omitted egg, or an extra slice of whole-wheat bread instead of the cereal. However, in modifying the foods in this way, it is essential that the total number of A.D.A. exchanges used from each food group at least reach the figure shown under column 4 of Table 1, that is, not less than 2 milk exchanges, 6 meat exchanges, 4 bread exchanges, etc. per day. Such modifications do contribute greatly to adjusting the diet to patient acceptance.

The Core Food List alone is hardly palatable as a routine diet. It lacks such gustatory items as butter and other fats and sugar and only rarely does the daily total of 1200 calories suffice to attain the second goal, the maintenance of, or approach to ideal weight. However, as will be discussed later, this plan is rarely prescribed as a diet without additions to make it a more acceptable means by which to achieve the first objective, that of getting the patient to eat at least the minimum amounts of the Core Foods.

Table 2.—Desirable Weights

Height in inches	Weight range in pounds Women	Men
56	94–104	.....
57	96–107	.....
58	99–110	.....
59	102–113	.....
60	104–116	.....
61	107–119	118–131
62	110–122	121–135
63	113–126	124–138
64	117–130	127–141
65	120–133	130–145
66	123–137	133–148
67	127–141	137–152
68	132–145	140–156
69	135–150	144–160
70	139–155	148–164
71	.....	152–169
72	.....	157–174
73	.....	161–179
74	.....	165–183
75	.....	169–187

The second objective is to be at, or to approach the desirable weight. As pointed out previously, desirable weight may be the patient's own weight at age 25 or a weight with reference to a population average. If a population reference is used, the following table (Table 2) has been found to be a useful guide. The weights in the table are based on the assumption that desirable weight at any age after 25 is 90–100 percent of the average weight at age 25–29 of the U.S.A. population, taken from the Metropolitan Life Insurance Co. tables (Metropolitan Life Insurance, 1960). This is believed to be as useful as any other definition. Allowances for the extremes of body frame can be made for the individual.

Since most people want and require more than 1,200 calories daily, an important consideration is what additional foods should be allowed. Theoretically one could say that as long as they are eating the Core Foods and are at, or approaching their desirable weight, they can eat anything else they want such as butter or margarine, sugar, sweets, pastries, salad oils, fried foods of all kinds, and modest amounts of alcohol. Theoretically this may be true, but in practice it is best to pursue a middle course. For the extra calories it is desirable to encourage patients to eat larger amounts of the natural foods of the Core list, but it must be remembered that food habits of the elderly tend to be rather firmly fixed, and the success of any diet hinges on adjustment to habitual food practices of the individual.

In modifying the Core Food plan for malnourished patients, it is the authors' experience that caloric increase by way of fats, oils and sugar takes top priority with the majority of elderly persons. For this reason, appreciable amounts of butter or margarine, of sugar and often of designated amounts of the patient's other favorite naked calorie foods are used to convert the Core Food list into acceptable diets at higher caloric levels. This element of choice makes the dietary modification much more acceptable to the average person.

In addition, the whole problem is simplified for the patient. He can readily learn what the Core food items are and the amounts to use (columns 1 and 2, Table 1). He then learns that to meet his particular needs

more calories are required and that he can obtain these by either of two methods, or a combination of the two—that is, (1) eat larger amounts of the Core Foods, or (2) add the calorically appropriate amounts of foods of his own choice, including items such as so much sugar, so much butter, so many cocktails, etc. A partial list of these commonly wanted foods and their caloric content, is given in Table 3. It has been found that a combination of methods 1 and 2 more often than not produces a diet acceptable to the individual patient and applicable to both hospital and nonhospital conditions. Even when eating at restaurants or at other people's homes, he can readily pick and choose the items he should eat.

As is well known to professional and lay people alike, modification of habitual diet can be exceedingly difficult to accomplish. Obviously, acceptance of the regime by the individual is of first importance, but

Table 3.—Optional Foods (19)

	Amount	Approximate calories
Fats:		
Butter or margarine	1 teaspoonful [1]	35
Cream, 18 percent, coffee	1 tablespoonful [1]	30
Cream, 36 percent, whipping	....do	55
Salad dressing, French or Italian	....do	70
Mayonnaise	....do	95
Thousand Island Dressing	....do	95
Cooking or salad oil	....do	125
Sweets:		
Sugar, granulated	1 teaspoonful	15
Jelly, jam	1 tablespoonful	55
Candy bar, Hershey chocolate	1 ounce	140
Desserts:		
Apple pie	⅛ of 9-inch pie	280
Cupcake, chocolate, iced	3 inches around	280
Ice cream, vanilla	Scoop, ½ cup	145
Snacks:		
Nuts, mixed	½ cup	440
Peanuts, shelled	....do	410
Popcorn	1 cup	65
Potato chips	....do	90
Pretzel	Medium size	80
Corn chips	½ cup	75
Cheese tidbits, nips	....do	145
Alcoholic beverages:		
Whisky—bourbon, Irish, rye	1 ounce, fluid	85
Scotch whisky, gin, rum	....do	75
Wine	....do	25
Beer	12 ounces, fluid	170

[1] Spoons giving standard measure are to be used and are to be filled level, not heaped.

NOTE.—Additional amounts of the core foods can also be used as optional foods. See table 1 for amounts and caloric values.

acceptance alone is not enough. To achieve success in this there are additional factors of great influence:

1. The importance of causative factors including organic disease, psychiatric disorders, social problems, chewing difficulty, and lack of money should be assessed and these factors eliminated insofar as possible.

2. The dietary regime must be as simple as possible without unnecessary restrictions being imposed and with as much catering to the individual's food likes and dislikes as possible.

3. The patient or family must be carefully taught how to provide the diet, with attention to food preparation and size of serving portions.

4. Some sort of discipline must be imposed upon the patient so that he must be weighed and report progress and problems at regular intervals.

5. The patient must clearly understand and accept the fact that rather than being reached in a matter of weeks, the goals realistically may not be attained for months or years, and that he must look forward to a permanent modification of his habitual diet.

From the previous paragraph it can be seen that various skills are needed to undertake nutrition therapy. It would probably be well for a competent physician, often with the help of a psychiatrist, to assess the medical status of all patients. The professional nutritionist and those trained in dietetics are needed to determine dietary intake and carry out diet prescription. The nurse can participate as a qualified professional, particularly if she has the interest and some specialized training. Lay persons, such as the wife who does the cooking, can be the principal source of guidance and assistance to the patient during the long haul. Finally, community services and agencies such as Visiting Nurse Associations and organized Meals-on-Wheels services can participate in programs for groups and individuals. Although the professionals perhaps should be involved in most cases, it does not follow that they have to be, except when it is necessary to rule out organic or mental disease. Once the patient commits himself to food therapy and understands what he has to do, he may need little or no professional assistance.

As stated before, acceptance by the patient is of first importance, and yet the factors which determine dietary habits and food acceptance are perhaps the most neglected subjects in the whole field of human nutrition. There are no good guidelines whereby the patient may be approached in a scientific way. Drugs have proved to be of little use, and psychotherapy has been of limited, although of real value. To modify food likes and dislikes, curb or increase appetite, and make a permanent change in habitual diet may require all the skills and intuitive knowledge of the physician, psychiatrist, nutritionist, nurse, cook, housewife and mother. Somehow the patient must be persuaded to accept food as he would a lifesaving drug such as digitalis.

In addition to the prescription of food in the treatment of malnutrition, two other measures can be taken —the prescription of supplements in pill or capsule form and the prescription of exercise. Whenever it is even suspected that the patient is not getting in natural foods the RDA's of essential nutrients, it is well to prescribe one or more of the commercial preparations, and to discontinue them when it is certain the patient has been eating at least the specified amounts of the Core Foods for a month or two and will continue to eat them.

In recent years, volumes have been written on the importance of exercise. Basically, exercise consumes calories helping to keep weight down, prevents atrophy of disuse, and can produce the trained individual whose physical capacity for work is greater than that of the untrained individual. Whether it has any other physiologic effects in man is, to our knowledge, unknown. In general, the authors feel that exercise is good for anyone of any age who does not have a disease contraindicating it. For the elderly, advice is given not to exercise to the point of being really tired, even if they may be motivated to continue. They are urged to move about more, walk instead of ride, jog, bicycle if they can, do their own chores, garden, and participate in sports such as golf, fishing and tennis doubles.

For the obese person, exercise is a positive factor in the calorie balance. For the non-obese, it can have a "tonic" effect, part mental and part physical, which results in a sense of improved well-being. For the depleted, underweight patient, exercise, usually under supervision, seems to be of benefit in some cases. However, it is not believed proper to harass the elderly person about exercise, particularly if he is not obese or does not have atrophy of disuse. It is urged with more or less conviction but without insistence that it be part of the regimen.

Therapy of Food Rejection

Among older people, the underweight person who is performing suboptimally is often encountered. Malnu-

trition may be his only soluble problem, and if he has organic disease, it may contribute materially to his total disability. When the obvious reasons for his poor intake, such as lack of money, have been eliminated, the other causative factors that we have described must be systematically dealt with. Usually, experience has shown that uncomplicated food rejection emerges as the major cause. The patient simply won't eat the food that is readily available. The best approach to this is to provide smaller serving portions, more frequent feedings, cater to the patient's likes and dislikes, and encourage him to eat everything offered—the clean plate technique.

In the beginning, it may be necessary to reduce the amounts of food offered well below the 1,200-calorie level before he will clean his plate. Often added to the 1,200 calories of the Core Foods are 300 calories of foods to make the diet acceptable, and this is offered in half portions to the patient. The objective, then, is to have the patient clean his plate even though he is only getting 750 calories, which often are more calories than he had been taking. Even at this level, it is frequently necessary to give more than 3 feedings per day. Once he is cleaning his plate the size of serving portions is increased until his intake is 1,500 calories, at which point additional food items can be added according to his choice. Finally, a calorie level is reached where he begins to gain weight and continues to clean his plate.

It is to be stressed again that it is necessary to cater to the patient's likes and dislikes as much as possible both in the selection of the Core Foods and the foods making up the additional calories. Fortification is often a useful device. Milk solids can be added to eggnogs and ground meat or egg to soups. The regime requires much attention to details, and is usually best carried out in an institution, although the skilled housewife may well be able to do it in the home. Some of our methods are illustrated in a film (Squibb & Sons, 1967).

When such therapy is successful a remarkable change occurs in the physical and particularly in the mental performance of the patient. This may begin within a few weeks. The nonparticitating, depressed individual again becomes the sociable, alert, and happy person that he was before the food rejection began, perhaps many years ago. The good result may, of course, be in part psychotherapeutic in origin. He responds because of the attention given him and his realization that someone cares about him again.

Therapy of Unbalanced Intake With Adequate Calories

The problem here is the selective rejection of the Core Foods, balanced by increased intake of foods such as sweets or alcohol so that ideal weight is still maintained. The solution is to readjust the balance so that the 1,200 calories of the Core Foods are eaten and the total caloric intake maintained as before by reducing naked calories to keep weight at the ideal level.

Again the principal difficulty involved is food acceptance. The patient can be taught the principles of the Core Foods and the variety and size of serving portions, but persuading him to change his habitual diet is another matter. Too often his suboptimal performance is not obvious to himself or his family and he sees no reason to change. The borderline alcoholic who takes little exercise is a good example of this, not uncommon among the elderly. In the younger and middle-age groups, the growing suboptimal performance of such an individual is very familiar to industry.

Therapy of Excess Intake

The usual approach to the obese patient is to hand him or his wife a complicated list of foods with an assigned caloric value of 1,000–1,500. This is exactly the wrong thing to do. He looks over the list and can't find most of his favorite foods. Resistance immediately sets in and he consciously begins to plan how to cheat.

The proper approach is in three steps.

First, the physician or counselor must explain in as strong terms as he deems advisable the physical and social hazards of obesity.

If the patient tentatively accepts a reduction regime, the second step is to explain to him in detail the principles involved in setting up the goals and what the goals actually are, i.e. the eating of the minimal amounts of the Core Foods and the adjustment of calorie intake so that ideal weight is being approached. The time factor must be stressed. It is the authors' opinion that weight loss should be at the rate of one-half to 2 pounds per week for the average obese person. It is very important to keep in mind that a higher rate involves greater restriction and greater probability that the patient will not follow the regimen.

The third step is to make an educated guess as to what the caloric level should be and give the necessary instructions. If the patient is not completely sedentary, or if he is sedentary and can be persuaded to take some exercise, the caloric level can usually be set at 1,800 for men and 1,500 for women. As explained be-

fore, the prescription of foods which will make up the calories in addition to the 1,200 calories of the Core Foods will depend upon the determination of the patient's likes and dislikes. If at least some of his favorite foods can be allowed, the chances of success are far greater.

Again in actual practice it is believed unwise to harass the elderly obese but otherwise well-nourished person with a reduction regime, unless there is a very good reason for doing so. Any organic damage has probably already been done and it is often very difficult to change the habitual diet in the elderly. The pleasure of eating may be one of the few satisfactions left in life.

SUMMARY

In this chapter no attempt has been made to review the literature on the nutritional requirements of the elderly, the effect of malnutrition on longevity, how malnutrition may cause or increase the severity of organic disease, or how organic disease may bring about malnutrition. Rather, attention has been focused on the causes and effects of inadequate or excessive intake of food and regimens have been described whereby the inadequate or excessive intake may be corrected.

The authors have made their own definition of good or optimal nutritional state, to wit: Any individual without organic disease is well or optimally nourished if he is habitually eating, in natural foods, the National Academy of Sciences—National Research Council's "Recommended Daily Allowances" (RDA's) of essential nutrients, and if he is eating sufficient calories to be at, or approaching his desirable weight.

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SECTION B/CLINICAL PROBLEMS CLOSELY RELATED TO MULTIPLE ORGAN SYSTEMS

Part XIII/Rehabilitation

REHABILITATION AND THE AGED

By

Lester E. Wolcott, M.D. and Paul C. Wheeler, M.D.

"An aged man is but a paltry thing,
A tattered coat upon a stick, unless
Soul clap its hands and sing."

—William Butler Yeats
Sailing to Byzantium

BASIC CONCEPTS

Observations on Aging

The physiological processes of aging must necessarily precede the state of being aged. Neither the processes nor the state are synonymous with disease or disability. This explains the deliberate and divisive use of the word "and" in the title of this chapter.

Rehabilitation, a complex factor in itself, is an entity as distinctive as the aged condition. At times the two must be brought together in response to a specific problem, while at other times they have, and need, no relationship at all. Suppose, for example, that the population considered here is one of paraplegic rather than aged individuals. "Rehabilitation *of* the Paraplegic" would then be an acceptable title, since in that group: (a) similar pathological and functional conditions exist, (b) certain restorative procedures are known which reduce the subsequent disability, and (c) the condition is a localized medical abnormality. None of these features apply to the aging process and the people affected. Consequently, rehabilitation of the aged is a meaningless phrase. At best, it merely insinuates that all aged persons need to be rehabilitated.

The processes of aging are poorly understood. One element is undeniably implicated, and that is the passage of chronological time. Identifying other factors is as difficult as explaining the different rates of aging between individuals during the same interval. The utilization of various modern techniques makes it possible to study biologic structures from hosts of different ages and to derive long lists of comparative tissue and functional alterations. For example, we know that the renal blood flow of the average 80-year-old individual is about half that of a person in the fourth decade, and that the central nervous system of the latter contains about 25 percent more fibers than that of his older counterpart. Other comparative differences are noted in Table 1 (Shock, 1962). Factors which retard or accelerate all such bodily changes are of great current interest to researchers.

Hippocrates (circa 400 B.C.) postulated that aging was caused by a gradual loss of body heat. More recently, 3 other generalizations have appeared in the literature (DeRopp, 1960). These attribute aging to: (1) the gradual accumulation of harmful substances, i.e., metabolic wastes, (2) adverse imbalance of the normal consumption-replacement ratio of vital materials, and (3) gradual dehydration. Of even greater interest is the author's speculation that senescence begins when growth ceases, thereby suggesting that longevity of a species is related to its time requirement for reaching physical maturity.

Gerontologists are presently turning their research interests toward so-called "fixed" tissue cells, that is, those cells which are no longer capable of division. This is because such cells suffer damages which are cumulative, and thus provide evident changes which are accessible for long-term studies. Even the ubiquitous fruit fly is becoming involved in some sophisticated intracellular probing of the aging process. Some of these studies, for example, include macromolecular cross-linking as it affects desoxyribonucleic acid (DNA), effects of free radicals upon vascular fibrosis,

Table 1.—Residual Physiological Functions or Tissues of Average Male, Age 75, Compared to Average Male, Age 30 Years (100 percent)

Functions or tissue	Comparative residual	Functions or tissue	Comparative residual
	Percent		*Percent*
Brain weight	56	Oxygen uptake during exercise	40
Brain blood flow	80	Pulmonary ventilation; exercise volume	53
Rapidity of blood to return to normal pH	17	Breathing capacity; maximum voluntary	43
Cardiac output, resting	70	Pulmonary vital capacity	56
Total kidney glomeruli	56	Hand grip	55
Glomerular filtration rate	69	Work rate, maximum	70
Renal plasma flow	50	Work rate, short bursts	40
Fibers, nerve trunk	63	Basal metabolic rate	84
Nerve conduction velocity	90	Water content, body	82
Taste buds, total	36	Weight, male	88

tissue vulnerability to autoimmune attack, lysozymal enzyme damage to nuclear DNA, and other factors of similar potential for unraveling basic mysteries.

A somewhat broader classification of the aging process is frequently used. It states that *primary aging* is that due to the passage of time, while *secondary aging* is that considered to be the result of a decline in functional efficiency due to severe trauma or chronic debilitation.

Long skeptical of the legerdemain which legislates certain ex-civilians into gentlemen, we nevertheless concede that this same rite can create an aged person as easily as his 65th birthday cake. It has been found, however, that this geriatric creation may be comparatively more challenging from a restorative viewpoint, since his latent cerebral drive and flexibility often exceed his physical capacities. Even though most physicians realize that chronological age is an unreliable determinant of physiological age, the former cannot be totally ignored, since it is the one known contributor to the aging process. The incidence of physiological decline following forced retirement at age 65 or 70 is well recognized. To debate the issue of employment regulations is superfluous, but the sequelae to inactivity following enforced job displacement constitute a significant social dilemma.

In any attempt to provide meaningful guidelines relative to rehabilitation and the aged, it becomes increasingly difficult to ignore the magic number 65. For practical reasons, therefore, it is necessary to pay reluctant homage to that figure. The categorical use of the terms "aged" or "geriatric" will henceforth indicate either those persons of age 65 or older, or those individuals whose physiological processes have produced functional aging through severe trauma or systemic disease. Having thus set forth parameters of inclusion, it shall be the intention here to ignore the semantic squabble that labeling this group seems to incite (Reed, 1966). If restorative measures are tailored to the particular impairment of the individual and not to his number of birthdays, then in most instances, the definition of "aged" is of no special meaning. It simply alerts the rehabilitation team to problems often superimposed upon those of the primary diagnosis. The U.S. population at risk numbers about 61 million persons over age 45, of which about 20 million are 65 or older.

Before rehabilitation can be discussed meaningfully in any age group, it is necessary to understand the specific implications of three common terms: impairment, handicap, and disability.

Definitions

Impairment is an objective, quantifiable pathophysiological condition. It does not always result in secondary disability. On the witness stand or elsewhere, the physician can verify impairment by various tests and examinations. He cannot, however, do more than estimate the degree of disability which such impairment might produce in a given individual.

Handicap always follows impairment, and is often combined with some disability. The latter may be en-

tirely absent, however, despite both severe impairment and its accompanying handicap. A handicap is simply an extra burden which the individual must either overcome or circumvent to avoid significant reduction of a specific functional ability.

Disability, the most misused and abused of these terms, does not refer to any anatomical defect. It is only a descriptive means of inferring subnormal activity. Although some type of pathology usually exists, it is not a prerequisite for disability. For example, one would not consider globe-circling musician George Shearing to be vocationally disabled simply because he is blind. Yet, if a person states that feeling unwell precludes his coming to work one day, he is, for all practical purposes, disabled. Disability is not always measurable by objective methods. Failure to function at a level reasonably expected for a given individual, with or without obvious defects, is the sole criterion for establishing disability. The legal implications here are apparent. A claimant's failure to function, which is *ipso facto* evidence of disability, often causes the jury to mistake this as proof of, and synonymous with, acutual physical or emotional impairment (pathology). There are approximately 4.1 million apparently disabled persons who are "unable to carry on their major activities;" this includes all types of disability, all ages, and both sexes.

In summary, it can be said that objective impairment inevitably produces a handicap, which may or may not result in a degree of disability. The relationship among these three conditions is exemplified in a famous superstar in baseball, who has severe destructive impairment in both knees. The damage produces a handicap, and despite every effort his running ability remains subnormal. Thus a degree of secondary disability is present. The disability is minimal, however, as indicated by his batting power and annual six digit salary.

It is not difficult to define *rehabilitation* if one uses the traditional jargon. A standard definition has long been popular, which states that "rehabilitation is the restoration of the handicapped individual to the fullest physical, mental, social, vocational and economic usefulness of which he is capable." Although this definition if found lacking on a few minor points (not the least of which is the subjective implication that one must be "useful" to justify his continuing existence), it nevertheless states the essence of rehabilitative activities. Rehabilitative, rehabilitation, and restorative programs are considered interchangeable terms of synonymous meaning.

Long-Term Goals

In accordance with the definitions set forth, it is now possible to state that the aged person is also a handicapped person. This statement is, in fact, redundant, since pathophysiologic processes of aging result in generalized impairments, and therefore a subsequent handicap. It is here that another factor, diagnosis, enters into the rehabilitation process, although not always in the most obvious manner. By various tests and other means, the characteristics of the impairment, the handicap, and the disability are determined. But what if these items are only slightly related, or totally unrelated?

Fitting a prosthesis to a grumpy amputee is unlikely to alter his attitude significantly if he then returns to a third-floor flat where he exists in isolation. The real rehabilitative challenge may be much deeper. A shiny new leg does not guarantee increased motivation or self-respect.

The goals of a geriatric rehabilitation program are necessarily somewhat different than those for a younger individual, as we shall point out later in the Geriatric Profile. Vocational factors often require less attention, while the avocational implications may be quite significant. Social and recreational concerns are also altered and spiritual values often take on greater meaning. Rather than aiming toward physical improvement, the general trend of therapy is to attempt to improve function within limits and activities judged reasonable, to maintain functions without undue stress, and to slow corporeal deterioration. Foremost of the physical aspects is the prevention of secondary complications such as muscle contractures, decubitus ulcers, superimposed infections and disuse atrophy of muscle and supratentorial components. Iatrogenic complications are especially inexcusable burdens to this patient-group.

Restorative goals must be realistic. The energies of both patient and staff are directed toward those areas offering greatest potential for independence and/or improvement. Rejuvenation is not a valid goal. Rather, the basic target is that condition which provokes the greatest personal frustration for the patient.

Daily Objectives

As noted, the long-range goals of the geriatric restorative program include reasonable functional improve-

ment, maintenance of existing abilities, retardation of deterioration and prevention of secondary complications. The precise daily regimen will vary according to the particular individual and his apparent needs. For these reasons, the daily objectives are necessarily comprehensive and generalized.

The patient's cooperation is mandatory. Factors tending to limit the needed cooperativeness may be physical or emotional, and are more frequently the latter. Thus, mobility and personal independence are compromised by frustration, distortion of self-image, and the insecurity which the new threatening environment creates. The primary condition may result in pain, increased debility, and generalized weakness which may be compounded by nutritional deficiencies. Some of the primary daily objectives of attending personnel should be to provide a stimulating atmosphere and an opportunity to overcome these obstacles. As a result, this should enhance cooperation and thereby augment the patient's innate drive to solve his problems. Organized daily activities must be highly professional, individualized, firm but flexible, and warmed by empathy. There is no place in a competent staff for pity, sentiment, or attitudes of self-aggrandizement.

Rehabilitation: Who, When, Where

Once the primary diagnosis is reasonably certain, the physician is confronted by three related questions regarding his aged patient. Is the person a likely candidate for rehabilitative measures? Should certain restorative activities be initiated now, or can they be postponed without risking the added burden of secondary complications? If and when rehabilitation is indicated, what type of environment is best suited to that patient's needs?

Unfortunately this logical reasoning sequence is not possible for every physician, since he may lack the necessary background and experience. Even the rehabilitation-oriented doctor may find these decisions surprisingly confounding.

FACILITIES AND PERSONNEL

Rehabilitation Environments

The particular locale and its rehabilitative hardware and personnel determine, in most cases, the regimen to be prescribed by the physician. This is especially true for the geriatric patient. Accordingly, we shall discuss the four most common environments and show how each may respectively affect the individual's restorative program.

Home Residence

The majority of rehabilitative measures for the aged probably could, and should, be conducted in the home environment. Pilot studies have demonstrated the efficacy of this approach (Stone et al., 1968; Wolcott et al., 1966). Only in certain circumstances is institutionalization more effective or essential to the patient's welfare. If individual differences in persons and homes are momentarily disregarded, the home program may be characterized as follows:

Advantages.—Some of the *advantages* of a home program include: (1) emotional security of familiar people and personal possessions; (2) less inconvenience for self and family if regimen is not too demanding; (3) unbroken rapport with family phyisican; (4) freedom of institutional facilities for those patients to whom they are essential; (5) marked reduction of expense to patient and society; (6) restorative result is usually equal or superior to that obtained in other environments.

Disadvantages.—Some of the *disadvantages* of the home program include: (1) lack of motivating stimuli provided by new experiences and expert professionals; (2) exposure to inappropriate, but well-intentioned, treatment by family or friends (e.g., overprotection, indulgence); (3) tendency to backslide on prescribed regimen due to absence of established routine; (4) necessary special equipment not always available or adaptable for home use; (5) local health personnel not in all cases adequately trained or motivated to initiate a home program and make intermittent followup home visits; (6) home environment and/or the particular impairment possibly contraindicates any disposition other than insitutional handling of problem; (7) the aged patient is perhaps considered an unwelcome "burden" by other members in the home environment.

There are numerous other intricate factors involved in considering or adopting a home restorative program. Limitations of practicality are evident here, however, and we must accept the above brief presentation only as a most superficial introduction to the subject. More extensive reviews are readily available elsewhere.

Formal Rehabilitation Facility

This environment for restorative programs may be an isolated, single-purpose institution or a specialized

department within a general medical complex. In some ways it is the extreme opposite of the home environment.

Advantages.—Many of the criteria by which this type of facility is selected over other possibilities have already been listed above as "disadvantages" in the home environment. Their importance justifies mentioning them again, but rephrased to emphasize the significance of each in this new atmosphere. Therefore, some of the major *advantages* of, or indications for, referral of the handicapped aged patient to the formal rehabilitation facility are: (1) need for continuous expert medical care not available elsewhere (i.e., for acute quadriplegia, stroke); (2) availability of diagnostic and therapeutic equipment not usually accessible in other facilities; (3) existence of subtle, supportive independence-oriented atmosphere that rehabilitation professionals intentionally create; (4) comprehensive evaluation and treatments by the multifaceted team of allied health personnel; (5) provision of balanced environment of emotional support and motivating stimuli; (6) minimum overprotection and gradual withdrawal of assistance to allow the patient to realize his optimum potential; and (7) staff and facilities able to care not only for acute problems, but also for those chronic restorative problems which demand patience and long-term observation.

Disadvantages.—Of course, the special rehabilitation facility is not indicated for every aged candidate (Roth and Eddy, 1967). Each case must be considered with the following *disadvantages* in mind: (1) patient's limited restorative potential, not justification for priority over other impaired persons on the referral waiting list; (2) patient's psychological reaction to displacement from accustomed surroundings possibly more damaging than any offsetting restorative gains; (3) occasional tendency of staff to prolong program in attempt to reach unrealistic goals; (4) sheltered, perceptive environment perhaps misleading all concerned in judging patient's ability to function under less ideal circumstances on the "outside"; and (5) provisions of long-sought security for some aged individuals, thus fostering hypochondriasis, malingering, and other mechanisms to extend their rehabilitation program.

Extended Care Facility

This unit is either a specially qualified nursing home or a special section in a general hospital. In the latter instance, it is not to be confused with the formal rehabilitation facility that might be located in the same physical plant. The primary purpose of the Extended Care Unit is to provide a level of health care midway between that of a hospital and that available in the patient's home. In essence, it is a "half-way house" which provides gradual transition and adjustment.

The Extended Care Facility became an officially recognized term in January 1967. At that time, the U.S. Medicare program specified minimum criteria to qualify for partial government subsidization of fees. Other criteria established an individual's eligibility regarding payments, but not for his admission to the facility at his own expense.

The professional staff is not as extensive as that of the rehabilitation institution. Certain standards must be met, however, and arrangements are provided for physical therapy, occupational therapy, speech therapy, and certain other health needs.

When the patient reaches his maximum functional potential, he usually is discharged and returns home. In other cases, circumstances may require that he remain in a more sheltered environment, where functional demands do not exceed his abilities. Many extended care units also offer domiciliary provisions, and thus the patient can remain within the same building complex. Nominally and legally, his place of residence is then considered to be a nursing home.

Domiciliary or Nursing Home

To clarify the preceding statement it is pointed out that most Extended Care Facilities also provide long-term nursing home quarters. The reverse is not true, since few domiciliary institutions can meet the required Government standards.

The U.S. National Health Survey estimated that in July 1967 there were 756,239 persons in 19,141 nursing care and related homes. The quality of these institutions ranges from firetrap hovels to the most elegant accommodations. Fees paid by residents are usually proportionate to services received, although health care rarely exceeds the level of adequacy which local laws and conscience demand. Data on noninstitutionalized impaired citizens, (Table 2) is included here to show the possible future demands upon existing resources.

For many aged persons entering a nursing home, the experience represents figuratively, and often literally, the end of the line. Only a few individuals consider this facility as a long-sought refuge. The male often finds his self-image severely disturbed, while the female tends to view her new role as evidence of rejection by society (Lieberman and Lakin, 1963).

Table 2.—Aged Noninstitutionalized U.S. Population With Moderate Functional Disability: Grouped by Impairment, Age, Prevalence

General impairment	Specific population			Total
	Under age 45	Age 45–64	Over age 65	
Arthritis and Rheumatism	331,000	1,267,000	1,650,000	3,248,000
Vascular lesions of central nervous system (including stroke)	22,000	219,000	452,000	693,000
Heart conditions and high blood pressure	509,000	1,917,000	2,360,000	4,786,000
Orthopedic impairments (excluding paralysis and amputations)	1,424,000	1,277,000	857,000	3,558,000

Psychosocial research, political pressures or aspirations, and altruism are some factors which have helped to elevate the overall quality of nursing homes. These factors also occasionally create problems. Lagging somewhat behind official interest now shown in fixtures and fire escapes has been professional concern for rehabilitative emphasis within the nursing home environment. Consequently, unable to compete with larger institutions for health specialists, the more determined nursing homes are now seeking ways to reeducate their present staff. These perceptive institutions and their geriatric patients offer the physiatrist and local physicians an opportunity to satisfy multiple needs. The traditional Old Folks' Home is an anachronism on its way into oblivion, but at a pace far too slow.

Rehabilitation Team

The increasing emphasis on rehabilitation in the last two decades has produced, in addition to the new medical specialty of Physical Medicine and Rehabilitation, the body of personnel known as the "rehabilitation team." For the geriatric patient, team membership is somewhat altered in composition and influence. These changes are dictated by two major factors: *first*, the response of the aged person to the combined effects of environment, people, and his general condition; *second*, the special needs that these effects induce, in addition to those of a universal nature. Since the rehabilitation team must function within the confines of the total restorative situation, the individual roles which are practical rather than standard will be adopted here.

The Patient

The team leader and greatest contributor to the program is the patient himself. While he alone may not be able to make the program a success, he can assure its failure. This does not preclude his being led in the direction of more positive, constructive self-care activities. However, being led by more experienced personnel is a subtle business he may accept, but rarely will he acquiesce to outright direction. Regardless of the conscious role he decides to play, his subconscious motivations are potent determinants of successful rehabilitation.

Supporting Personnel

Often overlooked is the second most vital member of the rehabilitation team, which is actually a plurality. This group, for lack of a better term, can be called "supporting personnel." These members are not usually included in the traditional textbook description of a rehabilitation team. Their identities vary according to the environment and their individual personalities.

This group may consist of family members or old friends. It may be several cleaning ladies, the entire crew of the night shift on the ward, or it may be two favorite orderlies and the night watchman. These supporting personnel are linked by two common denominators; that is, contact with the patient is nondirective and unhurried, and each member spontaneously supplies what the group title implies, support. In fact, a friendly tray girl can be as supportive to these patients as the schoolhouse janitor is to an anxious student sneaking a smoke in the boiler room. The janitor, listening patiently, will never alter the need for a competent school principal. Their distinctive qualities are directed toward the same goals, and so it is with the physician and his various supportive coworkers.

Career Professionals

Next in line on the geriatric rehabilitation team is another group, rather than a specific individual. Its members constitute part of the more traditional team of career professionals. Each has intimate daily contact with the patient and is continually in a better position to establish effective rapport than other team members. Through these individuals, the geriatric patient receives an extra degree of inner reassurance.

Rehabilitation nurse.—In addition to her usual nursing duties, the rehabilitation nurse directs her attention to promotion of functional independence in the patient. She and her staff assume the major responsibility for preventing secondary complications. Some duties carried out at this level include proper positioning of the patient in bed, attention to bowel and bladder function, passive exercise of joints and muscles, and numerous other functions. The nurse also reinforces skills which other team members have taught the patient. For example, proper use of prostheses or adaptive devices, special transfer techniques from bed to wheelchair, methods to manage the activities of daily living, and communication skills are items which receive her attention. The nurse also serves as a major link with family members, to whom she provides needed instruction in procedures for which they may later be responsible.

Physical therapist.—The primary responsibility of the physical therapist is to provide treatment through the use of various physical modalities. He also teaches the patient basic functional activities (e.g., ambulation, wheelchair transfer, more efficient respiration). Very often he is also called upon to provide instruction in the use of common household articles, which may be substituted for the more elaborate facilities used in the institutional setting. Another job is to teach the techniques which may be practiced under the supervision of the rehabilitation nurse or at home later without supervision.

Physical therapists also utilize various types of exercise, heat, cold, whirlpool, ultrasound, and diathermy. The parameters of each regimen are prescribed by the attending physician.

Occupational therapist.—The title of this team member is somewhat misleading, since his primary concern is neither vocational training nor keeping the patient "occupied" with busy-work. Some procedures and materials used, such as tooling leather or working a loom, do not show the true purpose of the activity to the uninitiated observer. All occupational therapy techniques are designed to increase either range of motion, strength, dexterity, coordination, or some combination of these elements. By using craft techniques the occupational therapist controls sensory-motor behavior, and thus improves basic neurophysiological integration of the patient. The occupational therapist also is responsible for supplying, by purchase or innovation, a variety of adaptive devices which the patient needs to accomplish certain activities of daily living. (One example is the instruction of a hemiplegic in fastening his shirt with an old-fasioned button hook.)

Imagination, creativeness, and ingenuity are indispensable assets to this team member. All the above activities comprise the major portion of the responsibilities of the occupational therapist. Occasionally he even serves as consultant-designer in remodeling a home to meet the handicapped occupant's special needs.

Speech pathologist or therapist.—The ability to communicate is essential if one is to function as a human being in any social setting. Since hearing is one vital component of speech process, these personnel must also have sufficient training in audiology in order to obtain and interpret audiograms as an adjunct to the diagnosis and treatment of speech disorders. Technically, advanced training qualifies the pathologist to make diagnoses, while the therapist is limited to treatment on an empirical basis. (In actuality this distinction is more academic than real.)

Speech disorders can cause extreme frustration. This expert is therefore in a unique position to be supportive and build self-confidence in the patient. The more common disorders in the geriatric group are aphasia following a stroke, and various forms of dysarthria due to disturbances of innervation of the speech musculature.

Social worker.—A major role of the social caseworker is commonly that of liaison among the patient, family, and other team members. This individual must have a most intimate and complete knowledge of the patient's world—as the patient views that world. Obtaining such a global impression usually requires extensive personal effort and investigation. Often the social worker finds it necessary to travel to the patient's home town, contact community resources for future care, arrange for more appropriate living quarters, and perform many other time-consuming tasks. If the rehabilitation team is well organized and operating in an effective manner, this member's recommenda-

tions significantly influence the course of therapy and its ultimate outcome as a rehabilitative effort.

Recreation therapist.—This person is one of the more recent professionals to join the rehabilitation team. With regard to need for expert avocational guidance, however, the demand has long existed, particularly in regard to the more dependent, uncreative aged person. This therapist serves all age groups, of course, but is more likely to be needed by the very young and the elderly when working in a formal rehabilitation environment.

Through acquired knowledge in psychology and specific recreational skills and equipment, the recreation therapist concentrates on an area of human need that formerly was either ignored or shared in piecemeal fashion by personnel with extra time or interest. Much more is involved than simply providing dominoes or Chinese checkers.

Academic degrees are now offered in recreation therapy, but only a limited number of institutions are technically qualified at present. As a result, supply is not keeping pace with demand for these specialists.

The Physician

At about the fourth echelon on the team, the physician can rightfully claim to influence the geriatric patient. The strain on his ego notwithstanding, with the physiatrist backed by a complete rehabilitation team, this appraisal is realistic. Through the team members, his indirect effect on the outcome of the program is beyond dispute.

It is a different matter, however, when the attending physician is supervising a home program without benefit of elaborate equipment or ancillary personnel. To this practitioner and to the local visiting nurse (if the community has one), a greater total influence on the patient is unhesitatingly conceded by the less intimately involved physiatrist.

As nominal head of an extensive facility, the physiatrist cannot handle by himself all the worrisome responsibilities for every patient treated in his department. Ward rounds, clinic appointments, paperwork, teaching duties and numerous other details make close rapport virtually impossible. A vital and respected leader, the physiatrist must often share the anonymity of the cloistered school principal. He nevertheless takes quiet pride for unrecognized contributions to the various restorative programs. If the regimen proves successful, nothing is diminished when the night watchman receives a card at Christmas and the doctor's name is forgotten. The physician who feels threatened by this situation is a confirmed string-puller and must find gratification with younger, more malleable minds.

Orthotist and Prosthetist

The orthotist and prosthetist are two technical specialists who are not involved with every patient, but only with those requiring assistive bracing devices or artificial limbs. The orthotist is skilled in custom-manufacture of bracing components to assist existing body parts in their function. The prosthetist, on the other hand, is concerned with providing artificial functional replacements for missing limbs. Each is a highly trained technician. In addition to actually making the particular devices prescribed by the physician, each also works as a close consultant during initial fitting, adjustment, needed modifications, and subsequent training of the patient. This responsible attention to the patient's needs is the only acceptable procedure for reputable orthotists or prosthetists. Unfortunately these standards of conscientious total care are not always uniform or available. The prescribing physician is therefore obligated to personally know and supervise his technical consultant, if optimum care is to be provided.

Inhalation Therapist, Peripatologist, Volunteer Worker

There are at least three additional types of rehabilitation personnel who may become involved with the restorative programs of certain patients. When on the team, they are no less important than those members whose contributions are more routinely needed. They are: (a) the *inhalation therapist,* a trained specialist in improving respiratory function by various prescribed techniques and mechanical equipment; (b) the *peripatologist,* a trained specialist who teaches orientation and mobility techniques to visually handicapped persons; and (c) the *volunteer worker,* whose duties are too extensive to enumerate. Generally, it can be said of the volunteer worker that, properly motivated and carefully screened, he is an extremely valuable member of any rehabilitation team. Unless well selected and supervised, however, the unqualified worker can be a disaster to the organization and to the patients.

Psychiatric Social Worker and Clinical Psychologist

Team inclusion of the psychiatric social worker and the clinical psychologist will be determined largely by the patient's needs and emotional state. The question always arises as to where these disciplines fit into the artificial ladder of team membership. The top rung is

fixed, since it always represents the one unexpendable component, the patient. The others, according to circumstance, are more interchangeable. The cliché that each patient presents an individualized complex of problems is unavoidable. Therefore, in this emotion-oriented framework, these two professionals become the team's most mobile influences.

THE GERIATRIC PROFILE

Psychological Factors

Without a functioning brain we are nothing, and yet nothing is nearly all we know about its function. The familiar term "senile" is customarily used as a synonym for senile dementia of an organic etiology. Linden (1964) prefers to call such definitive changes psychological *recession*, and considers nonorganic emotional alterations in the aged as psychological *regression*. While he feels that recessional changes are more apt to be irreversible, he nevertheless believes that both psychological traits, particularly regression, are potentially within the physician's sphere of therapeutic influence. Accordingly, we have discarded the word senile and its implication of finality, and have chosen to substitute the more hopeful term, "pseudosenile." In this way the rehabilitation staff is subconsciously directed to view the patient in a different perspective.

Pseudosenility therefore indicates a newer concept of pathophysiological depression of cerebral function regardless of histologic change. Repeated failures to correlate atherosclerosis with functional alterations in cerebration suggest that such a distinction is warranted.

Observations of subjective behavioral changes in the majority of disturbed patients undergoing rehabilitation are often misinterpreted. The error occurs when one considers the behavioral change to be the result of the restorative regimen prescribed. We should actually think of the observed phenomena as requiring explanation in terms of physiological processes.

The central nervous system has two principal neurophysiological properties, reactivity and plasticity. A system's *reactivity* allows it to be activated by stimulation of its receptive (sensory) components and depends upon neuronal excitability, transmissibility, and conductivity. On the other hand, *plasticity* refers to the capacity of the nervous system to modify its reactive characteristics after repetitive afferent stimulation. Volumes of data exist concerning reactivity, but plasticity is a poorly understood, yet readily observed, trait in higher animals. These are the aspects of the aged brain with which we are concerned here. In order to better understand this concept and its clinical relevance, it will be helpful to briefly review some historical stepping stones.

Early basic research on the central nervous system arbitrarily separated studies of the spinal cord from those of the brain. Sherrington's classic work on the physiology of the spinal cord was entirely behavioristic. Working with decerebrate animals, he applied external stimuli, recorded the resulting somatic responses, and thus determined objective evidence of spinal reflexes. Cajal's previously postulated neuronal basis of the nervous system caused Sherrington to form conclusions about the central control of spinal reflexes. Subsequent modern investigations with neurophysiological electronic equipment show these pioneering hypotheses to be astonishingly accurate.

Pavlov approached the physiology of the brain in the manner Sherrington had applied to the spinal cord. However, in his now famous discovery of conditioned reflexes, the latter were thought to be acquired rather than innate activities. His hypotheses regarding cortical processes differed somewhat from Cajal's neuronal theory, which itself was not fully accepted, and thus many of Pavlov's ideas relating to cortical physiology were abandoned. His major contributions, therefore, were in the area of the behavioral sciences.

Consequently, research on brain function has been divided into two rather unrelated disciplines: (1) electrical studies in anesthetized animals, and (2) behavioral observations, with minimal attention to their possible physiological bases. Only recently have the neurophysiologist and the behavioral psychologist attempted to correlate their work in an integrated fashion that might shed light on brain function in the awake condition.

A recent major effort in the latter direction is that of Konorski (1967). Of particular interest in regard to our present topic of pseudosenility, is his concept of *gnostic* cortical areas and actions, and how they integrate conscious perception with thinking and/or efferent activity. Penfield has strengthened this concept by precisely localizing anatomico-functional areas while stimulating discrete exposed brain sites in unanesthetized humans. Data relating to pathological brain lesions also strengthen these hypotheses.

To summarize, Konorski (1967) postulates an expanding hierarchy of chains of neural units which terminate in a gnostic area. Some of these areas are

"permanent," having been fixed by previous afferent impulses of sufficient electrical and/or chemical strength, while other areas are only potential and await the needed incoming stimuli to become activated and permanent. There are always potential gnostic units available. They may become functional by one or more types of afferent stimuli such as those of touch, vision, hearing, kinesthesia, proprioception, pain, and so forth. Experimental electrophysiological evidence is insufficient and controversial, but much behavioral observation has given this theory considerable credibility. It is these observations which suggest, through the mechanism just described, that repetitive afferent stimuli reaching the cerebral cortex of the pseudosenile patient may produce new functional gnostic units and thereby result in a more integrated, active, and motivated person. The same principle is also proving to be highly successful in certain "true" psychiatric disorders. Whether or not the above integrating theory explains the actual process, the empirical results in aged patients so stimulated cannot be readily dismissed. Konorski's belief that the number of unengaged (potential) receptive gnostic units decreases with age does not invalidate the basic theory, nor does it detract from the obvious success noted in clinical settings.

Therapy consists of minimizing sensory deprivation. This means that greater attention is directed toward providing the afferent stimuli necessary to promote more desirable affective and kinesthetic output from the pseudosenile patient. Failing this, exposure to a monotonous environment often induces untoward reactions. These include altered emotional responses, impaired thought processes, visual disturbances, hallucinations, and even changes in electroencephalographic wave patterns.

It is important to note that simply being exposed to sensory stimuli is not in itself adequate therapy. Impulses received repetitively in an unchanging, monotonous environment will be literally "tuned out" by the brain's receptors. Therefore the restorative program must take this into account and by careful planning avoid much of the stupefying, dull routines evident in many rehabilitation facilities. Personnel should not be deluded into thinking that efficient operation is an adequate excuse for failing to introduce creativity and variety into the patients' daily activities.

Thus far we have emphasized four major points regarding psychological factors in the aged: *first*, true, irreversible senility can be the result of certain cortical conditions, although such states are not as prevalent as is supposed, and unequivocal diagnosis is rarely possible; *second*, the less onerous term "pseudosenility" is introduced and the reasons for its usage are explained; *third*, a theoretical mechanism is presented which may give insight into the cortical integration of sensory stimuli and their facilitating effect upon behavior; and *fourth*, the basic tenets of this theory suggest that their potential benefits, through the mechanism of enhancing sensory input, warrant their introduction into geriatric rehabilitation programs. Definitive suggestions for implementing related preventive and therapeutic measures will be presented in the following section. We now turn to other geriatric emotional factors which deserve consideration.

Peculiar character traits sometimes displayed by the elderly are often mistaken as indicative of organic brain changes. In actuality, these changes may simply represent that person's emotions which he no longer feels obliged to conceal. From the viewpoint of others, these emerging traits may be either acceptable or disagreeable. For example, release from earlier conformities required for business success, marital harmony, or various social aspirations removes the usual reasons for suppressing the deeper emotions. Thus, a penny-pinching businessman may give free rein to hidden philanthropic wishes, while a bubbling civil leader may turn as sour as week-old yogurt.

These apparent personality shifts, Fromm (1966) points out, must not be considered necessarily pathological or beyond modification. In other words, most geriatric persons have earned the right to indulge themselves in their cherished, long-festering eccentricities, and each should be evaluated individually and with open-minded understanding.

Finally, we should remember that aging per se may not result in any noticeable change in one's previous personality. Some possess such reserves of ego strength and inner emotional resources that they are able to sustain psychic equilibrium in most altered circumstances. Emotionally, these people are able to function and thrive up to the very end.

Rehabilitation personnel, aware of the psychological factors just discussed, should enrich their patients' lives by enriching their environments. If a particular character trait arrives with the patient, it may respond dramatically to creative stimuli provided by the staff; should the trait develop during the restorative program, its possible cause should be determined and the most appropriate counter measures prescribed.

The essence of this entire psychological drama was captured many centuries ago: Plato tells us, "He who is of a calm and happy nature will hardly feel the pressure of age, but to him who is of an opposite disposition, youth and age are equally a burden."

Socioeconomic Factors

In general, the aged person is beset by three new categories of experience: situational factors, somatic disease processes, and biophysiological changes. We are concerned here mainly with the first obstacle, situational factors, and how they affect the milieu of the elderly.

It is virtually impossible to construct any population profile without combining the interdependent social and economic elements. If the components of the group are ailing and aged, this is especially true (Fisch et al., 1968). The present geriatric persons requiring rehabilitation, when viewed en masse, pose sobering problems for the country's economy and conscience. Several unprecedented circumstances have converged to create this situation. They are: (a) the overall trend of adult children to exclude aged relatives, either emotionally or totally; (b) the successful preoccupation of medicine to prolonging survival; and (c) the gradual national awakening to an unforeseen socioeconomic dilemma, and the resulting spurt of jerry-built placeboes. The aged generation upon which these things have converged is historically the first, and hopefully the last, to experience such a focus of disturbing pressures.

The avenues which offer the most likely means of reversing this national and personal indignity are evident; either the family must regain its former tangible concern for its elderly members, or widespread social reforms must be implemented that are personally and financially palatable for the majority. Probably a combination of the alternatives will prove to be an acceptable compromise. The fixed incomes upon which most elderly persons now depend are inadequate to the point of absurdity. Barely two-thirds of this group receive stipends above the official criterion set for minimum subsistence.

Present cultural emphasis on youth and youthfulness inherently devalues the nonyouthful. This places approximately 10 percent of our population, very conspicuously, in an undignified and ego-destroying position. One result is the evolution of another stereotyped minority. Its coincident creation of the "marginal man" (Goldberg, 1941) puts a different perspective on life for most Americans so affected. Rushing indiscriminately into the breach with material aids, planners often assist the needy while offending the independent. The unctious Senior Citizen label is unworthy of comment. We do not mean to infer that old people are simply young people who have been around longer. They do indeed have special needs and desires, but attempts to be altruistic must be tempered with realism.

Society is caught up in a paradox of its own making. While science has had remarkable success in prolonging survival, it has simultaneously failed to consider related socioeconomic aspects. This disquieting fact is now very apparent. Typically, we discarded the belief that old age is a transitory final step that must be tolerated momentarily, but we did not prepare for the unavoidable imbalances which would follow. This suggests that the philosophical turnabout was not taken seriously by all areas of leadership. The final result is but another classic example of the phenomenon of mass disassociation, followed by mass rationalization and projection of guilt. The medical profession has been accused of being the most flagrant offender, but that is another issue.

Kutner (1966) provides some rather biting commentary on what he calls, in irony, the "problem of aging." Among other remedial proposals, he cites: (a) maintenance of continuity in community life; (b) reforms in institutional living arrangements; and (c) prevention of factors which tend to alienate the elderly from society's mainstream. Our mutual wish is to stimulate positive corrective action, while simultaneously preventing individual traits from being suffocated by efforts at group reclamation.

There must be creation of a wider range of opportunity within which to exercise freedom of choice. Possibly, the elderly person wishes to dodder about in a multistoried cement womb, and that should be his prerogative. Another may wish to rough it alone in a log cabin, or settle on some midway alternative. Since society now seems obliged to broaden the scope of choice, so is the rehabilitation staff similarly bound to honor the basic need for variety of opportunity. The only lasting remedy for social ills is in interpersonal faith developed between the individuals who care. Society will then take care of itself.

Vocational Factors

Job placement of anyone who has passed his fourth decade is a subject fraught with controversy. If the person is also handicapped in some way, the related

discrepancy of opinions increases almost logarithmically. Without question, many of these persons are unsuited for prolonged vocational counseling and attempted reemployment. Usually such nonproducers can be identified by reviewing their record of previous job performances (work history).

There are, however, many subtle factors that combine to form one's past work history, present attitudes, and future aspirations regarding the basic instinct for dignified and satisfying work. Some vocational experts and employers can quote (with statistical backing) apparently valid reasons for not hiring, retaining, or retraining the aging and aged. Among the most frequent reasons cited are: (a) the need to make room for younger, more up-to-date personnel; (b) the desirability of infusing new-generation thoughts into the crusty traditions held sacred by elders; (c) the imposed limitation of fewer years during which productive work can be expected; and (d) the decrease in useful output due to physiological slowing of motor and mental processes. For some, these damning attitudes are, unfortunately, quite applicable and valid. The trick is to weed out the exceptions and to provide them with realistic job opportunities.

Pioneers in the field of special employment practices, such as Viscardi (Slipyan et al., 1959), have disproved many old theories regarding the severely handicapped worker which should apply equally to much of the elderly job-seeking population. The scientific and academic communities, despite some rather archaic retirement rules, have nevertheless recognized and made room for the enormous reservoir of abilities which their retired members can still provide. Industry is just awakening to this idle potential.

The latent viability of this untapped resource is exemplified by an incident which occurred in the early 1960's. A retired executive, frustrated and depressed, was unexpectedly asked to consult on a highly technical problem that had baffled the immediate staff. His unique knowledge quickly solved the seemingly insoluble. The jubilant consultant then went on to organize a group composed of other retired experts in various fields. They now provide, enthusiastically and without fee, on-location help with knotty problems throughout the world. Although this particular service is part-time and unpaid, it clearly emphasizes the fact that too much wise experience has been removed from a market that cannot afford this dubious luxury.

Studies dealing with vocational rehabilitation cases usually report good success rates among professional and business people. Manual workers show the poorest followup results. It is tempting to ascribe this consistent statistical finding to intellectual capacity, which is indeed a factor. However, *motivation* to work is acknowledged to be the most essential prerequisite for successful vocational rehabilitation. This fact is, of course, not news to those who work in the employment field.

We call attention to this situation because a critical element is rarely mentioned. It is this: most professional and business workers find their jobs to be enjoyable and satisfying, whereas a higher percentage of manual workers view their jobs simply as a means of earning a living. In other words, when work is gratifying and continued, the case records tend to suggest effective counseling; in groups where work is just work, the reverse occurs. Our own observations substantiate this concept. Vocational rehabilitation successes would be considerably higher in this latter group if greater attention were directed toward the individual's preference rather than toward the counselor's "objective" analytical decisions.

The aged and partially handicapped person who desires some form of satisfying employment is a challenge to the vocational counselor and physician. If the person's intelligence is adequate and his previous work was an enjoyable part of his life, we believe he will respond to opportunities for resuming the activity. Should impairment prevent this, he will often look for success in related work. We can only conclude that superficiality and smugness too often accentuate the role of intelligence scores when explaining tallies of successful job placements. Similar caution is urged when weighing the quality-values of youthfulness. As any floundering schoolboy can quickly remind us, Sir Winston Churchill not only failed English and other classes, but he was also a political dilettante until becoming prime minister of Great Britain. That was in his 65th year.

SPECIFIC RESTORATIVE PROGRAMS

The preceding sections about rehabilitation and the aged are a necessary prologue to a complex subject. Specific restorative programs, to be effective, must be relatively fluid and individualized, and yet be guided by stable parameters.

Each program varies according to its underlying cause and other influences. For this chapter to best serve the busy practitioner and his patients, it is neces-

sary to select and discuss those entities which are most apt to be of use. By integrating personal experiences, judgment, certain statistical factors and a leavening touch of common sense, four restorative programs seem most appropriate.

Those chosen for presentation below are: severe visual impairment, stroke, arthritis and related conditions, and lower extremity amputation. Their ultimate applicability is beyond our province.

Severe Visual Impairment

This subject receives priority because physicians are usually not prepared to deal adequately with blindness (Wheeler, 1965; Wheeler and Wolcott, unpublished data) in their patients, and because it is an impairment that often impedes restorative programs for other pathological conditions. For it to be most meaningful, blindness will be discussed first as a primary handicap, and then as a condition which complicates rehabilitation of other major disorders.

Impaired Vision as Primary Handicap

The physiological processes of aging invariably result in a degree of visual impairment. Numerous other conditions affect vision either directly or indirectly. The size of the population affected is unknown, but it is estimated that the total will approach one million by 1970 (National Society for the Prevention of Blindness, 1966).

In this discussion of vision loss as the primary handicap, two distinct, yet interrelated aspects are considered: (1) improvement of vision when such a possibility exists; and (2) maximum use of available rehabilitative services and resources.

Ocular surgery.—In selected cases, ophthalmic surgery may provide rapid and marked changes in the patient's ability to see. This is particularly true of *senile cataract*, the leading cause of blindness among adults. The degree of vision loss depends upon the extent to which both lenses have become opacified. Consequently, the aged person with cataracts may experience only slight visual disturbances, or his vision may be limited solely to the perception of light.

Glaucoma is the second leading cause of blindness in this age group. Although surgical intervention usually halts progression of the condition, permanent damage to the optic nerve rules out improvement of visual perception. If detected early and arrested, the irreversible glaucomatous visual impairment can be greatly minimized.

All persons over 40, and especially the elderly, should have routine tonometric examinations to detect increased intraocular pressure. Safe, simple and quick, this exam is a must for geriatric individuals. Any 5-minute procedure that is capable of preventing total, permanent blindness is a compelling example of preventive medicine.

Ophthalmic surgery may also reduce visual impairment caused by certain affections of the cornea, sclera, and other ocular components. The nonophthalmologist is referred elsewhere for further basic information (Newell, 1965).

Low-vision clinics.—These facilities have developed rapidly in the past decade. Studies have shown this type of service to be particularly beneficial to visually handicapped children and elderly persons (Milder, 1962; Hitz, 1967), and vision is improved in about two-thirds of cases.

The purpose of a low-vision clinic is to enhance visual function of selected persons through the use of prescribed special optical devices. These aids are not ordinary eye glasses. The variety ranges from rather simple hand-held magnifiers to precision-made, telescopic instruments worn with a headband.

The staff of a low-vision clinic usually includes, in addition to the supervising ophthalmologist, a specially trained optometrist, a social worker, a rehabilitation counselor, a clinical psychologist, and often other professional personnel.

Other resources.—There are numerous private and public agencies available to assist the visually handicapped person. Each State and U.S. territory has a central office to provide and coordinate needed assistance for eligible applicants. An applicant's visual acuity, but rarely his financial status, determines eligibility for specific services.

Most patients are unaware of available resources. It is therefore the responsibility of the physician and his staff to make the existence of these resources known to potential beneficiaries (Wheeler, 1967). Occasional encouragement and coordination of activities may be necessary in certain instances. Items of primary relevance, such as aids to the visually handicapped aged person, include: (1) free loan of recorded literature of all types and Talking Book record players,[1] (2) special instruction in daily living activities by trained teachers who visit the patient's home or place of resi-

[1] Library of Congress, Division for the Blind and Physically Handicapped, Washington, D.C. 20540.

dence, (3) special Social Security benefits, (4) special income tax concessions, (5) various sources of financial aid, (6) numerous special devices to facilitate daily living activities, (7) recorded inspirational materials, (8) counseling and related services. Further information about resources for the visually handicapped may be obtained from the appropriate State agency, or from the Nation's major voluntary clearinghouse for any aspects related to blindness.[2]

It is difficult to comprehend the psychological benefits these services and resources provide. Rehabilitation personnel should be alert to potential needs of the patients, and arrange the initial contacts if such actions seem appropriate. Recalling earlier discussion about the need for sensory stimuli, the possible psychic sequelae of impaired visual perception are obvious. Loss of this major pathway for incoming data, especially as it affects spatial orientation, social intercourse, and routine observations which most of us accept subconsciously, requires unusual understanding and empathy from the attending staff (Carroll, 1961). An unperceptive staff can allow a formerly adequate personality to be reduced to a withdrawn, shell-like state.

Impaired Vision as Complicating Secondary Handicap

Approximately 55 percent of the present estimated blind population are individuals of age 65 or older. Some characteristics of a portion of this group are shown in Table 3 (National Center for Health Statistics, 1965). This fact, when combined with our previous definition of the "aged", suggests 3 disease states with complicating ocular problems which are conspicuous rehabilitative challenges. Each has a different ocular dysfunction, but their effects on restorative programs are similar in many respects. They are discussed below in order of decreasing prevalence.

Visual complications of stroke.—A variety of motor and sensory ocular manifestations are possible, depending upon the etiology and severity of the stroke and the vessels involved. The most common visual defect is homonymous hemianopsia, in which all or part of a lateral half of the visual field is lost. Patients usually are unaware of this limitation. Homonymous hemianopsia may be caused by hemorrhage within the internal capsule of the midbrain or by thrombosis of the middle cerebral artery and occasionally of the internal carotid artery. There are many possible bizarre visual sequelae which may require precise ophthalmologic evaluation to detect.

Prognosis for clearing of these visual impairments is guarded, particularly with internal capsule hemorrhage. Accurate ophthalmic diagnosis and proper training can often help overcome the handicapping sequelae.

[2] American Foundation for the Blind, Inc., 15 West 16th Street, New York, New York 10011.

Table 3.—Severe Visual Impairment Among Aged Institutionalized Patients: Prevalence by Age, Impairment, Environment

Facility and vision status	Age 65–74	Age 75–84	Age 85+	Total 65+
Nursing home:				
Partially sighted	9,858	31,501	34,945	76,304
Legally blind	2,240	5,803	7,435	15,478
Total	12,098	37,304	42,380	91,782
Hospital:				
Partially sighted	1,594	3,881	2,980	8,455
Legally blind	442	628	680	1,750
Total	2,036	4,509	3,660	10,205
Totals, all types	14,134	41,813	46,040	101,987

Visual impairment in this patient complicates several activities. For example, reading may be difficult or impossible in such cases, but the presence of organic dyslexia must be ruled out. Retraining in ambulation may also be hampered, since the patient often fails to note walls and other objects on his "blind side." It is therefore helpful if the person assisting with gait training walks on the nonvisualized side. This not only provides physical protection for the stroke patient but also acts as a continuous reminder for him to adjust his orienting sense accordingly.

Visual complications of diabetes mellitus.—Three potentially blinding conditions have a significantly higher incidence among diabetic patients. These are cataract, glaucoma, and severe retinopathy. None seems to be related to the severity of the disease or the amount of insulin required.

Lens opacification in cataract is a result of localized acceleration of the aging process. The opaque lens often prevents adequate funduscopic examination of the retina. As a result, surgical removal of a diabetic cataract may not restore vision since previously undetected retinal damage may also be present.

The characteristic changes in diabetic retinopathy are irreversible microaneurysms of the retinal vessels and intraretinal hemorrhages. Occasionally, scarring and other pathologic changes will result in detachment of the retina. Due to this scarring, reattachment is impossible and total blindness results.

Other abnormalities may cause glaucoma, which may or may not respond to medication or surgery. The precise relationship to this and other diabetic ocular abnormalities is not clearly understood. However, fluctuations in blood glucose levels result in corresponding changes in accommodation; consequently, the diabetic's visual acuity may change intermittently during the day, and eyeglasses may provide little reliable help.

Most elderly diabetic patients undergoing rehabilitation are involved in a prosthetic training program following lower extremity amputation. Visual impairment, combined with loss of kinesthetic and proprioceptive sensations in the affected limb, greatly accentuate the inherent problems of gait training. However, severe vision loss should not preclude prescription of a prosthetic device.

Visual complications of multiple sclerosis.—Retrobulbar neuritis is most frequently caused by multiple sclerosis, and often precedes any other manifestations of the generalized disease. One or two attacks of the ocular condition may appear and subside before other central nervous system signs and symptoms become evident.

Nystagmus is present is about 70 percent of cases. Slight paresis of one or more ocular muscles may produce blurred vision without actual diplopia. Other ocular signs sometimes present are paralytic squint, dissociation of lateral gaze (internuclear paralysis); in the latter, ataxic nystagmus is evident in the abducted eye. Pupillary reactions are normal. These visual changes, like multiple sclerosis itself, are progressive and irreversible.

The total randomness with which the degenerative processes attack the central nervous system makes it virtually impossible to predict specific restorative problems. In general, however, it can be assumed that ambulatory function will eventually become affected. To facilitate mobility and provide protection for the awkward, visually-impaired patient, either a sturdy upright walker or a walking device that incorporates a platform for sitting may be used. As with the amputee, the most reliable method will evolve by trial-and-error.

Stroke

At least 2 million people now alive in the United States have suffered a stroke. About 80 percent survive the acute initial episode, and invariably have some residual impairment (President's Commission on Heart Disease, Cancer and Stroke, 1964). The primary early cause of stroke is intracranial arterial dysfunction due either to thrombosis, hemorrhage, or embolism, in that order of decreasing frequency. The incidence of carotid artery involvement in the neck is now becoming more widely recognized. The female:male ratio of all types of stroke is about 2 to 1.

The most common impairment of surviving stroke patients is paralysis on one side of the body. If the dominant cerebral hemisphere is involved, hemiplegia usually is on the side of handedness and speech is often severely impaired. Conversely, involvement of the subdominant hemisphere spares the extremities more often used, and speech is rarely affected significantly. In some cases, however, there may be severe aphasia, hemiplegia of the side opposite handedness, or a variety of motor and perceptive dysfunctions (Elliot, 1964). Regardless of the particular combination of impairments, the occurrence of stroke is a catastrophic blow to the individual and family.

Extramotor deficits may include receptive and perceptive abnormalities. Only discrete testing will reveal the degree and type of involvement. Despite the many

bizarre external actions which the patient may exhibit, it is essential that the attending staff realize that his capacity to think may be entirely unaffected. Therefore, all conversation directed toward or voiced in the presence of a stroke patient should be based on the assumption that cognition is intact. This frustrating sort of thoughtless treatment is lucidly described in an excellent first-person account (Hodgins, 1964).

The ability to comprehend all forms of communication is significantly impaired in some stroke patients. Obviously, this greatly complicates the restorative program. It has been shown, however, that patients who are unable to understand oral commands may have less difficulty with instructions given in pantomime (Fordyce and Jones, 1966). This possibility should be investigated by an experienced speech pathologist.

Definitive Diagnosis

The diagnosis of stroke is usually not difficult if the person collapses suddenly with obvious unilateral paralysis. Occasionally, however, the condition evolves gradually over a period of hours or days, as in the so-called "stuttering" onset of some thrombotic episodes.

The person who is discovered in a comatose state requires a more thorough differential diagnostic workup. Common conditions to be ruled out include diabetic coma, brain tumor, alcoholic stupor, severe brain concussion, poisoning, certain metabolic disorders, sunstroke, or extreme sepsis.

Marked unilateral diminution or absence of a carotid artery pulse suggests that the possibility of immediate surgical intervention should be considered (Debakey, 1966). The indications for cerebral arteriography, pneumoencephalography, radioisotopic brain scans, and similar procedures will not be discussed here.

Once the diagnosis of stroke is established and appropriate surgical and/or medical therapy is initiated, it is necessary to introduce certain rehabilitation-oriented measures at once. Subsequent continuing observation and investigation during the restorative program often reveal subtle diagnostic clues that can be of value in prescribing modifications or changes in the regimen.

Prevention of Secondary Complications

The most common preventable complications following stroke are: muscle contracture with resulting joint deformity; ischemic skin ulcers (bed sores); muscle atrophy; tight Achilles tendons; and mental depression and deterioration. Pertinent preventive measures will be discussed later; however, improper positioning of the patient in bed is the most frequent contributing factor.

Recent trends to mobilize the patient early, a recommended procedure in itself, has introduced some less well-recognized secondary complications. For example, glenohumeral distraction occurs if the paralyzed upper extremity is allowed to dangle unsupported, ischial decubiti develop from prolonged sitting, and severe contractures appear in the hips, knees, and ankles.

In most restorative programs, about 70 percent of time and cost is expended in the correction of secondary complications. The value of early preventive care is obvious.

Development of Exercise Tolerance

This process is somewhat analogous to getting an athlete "back in shape." In addition to developing the patient's endurance to physical activity, there is the unique feature of regaining cardiovascular stability. The guiding parameters of fatigue, dizziness, and so forth are similar to those of any recuperating patient, only the process is more gradual and lengthy.

Physical conditioning is predicated on the physiological need to reach, but not to exceed, the individual's capacity for enduring stress. While excessive fatigue in a stroke patient must be avoided, activity should nevertheless be pushed to the safest tolerable level. Otherwise, as Cooper (1968) has recently documented, the cardiovascular system cannot perform at its potential capacity.

The increasing of exercise tolerance requires a delicate weighing of several factors, and is the responsibility of the attending physician. A degree of risk is always involved. Although fatalities are rare in this phase of stroke rehabilitation, the family (and usually the patient) should clearly understand both the risks and the benefits of the regimen prescribed.

Development of Functional Abilities

Eventual self-care is a vital goal toward which restorative efforts must be directed. Following a stroke, the patient's family and even rehabilitation personnel often place undue prognostic and therapeutic emphasis upon regaining ambulatory ability. It is the physician's responsibility to see that the various self-care activities are viewed in their proper perspectives.

Learning to walk again without aid has definite

physical and psychological advantages. For the aphasic patient, however, learning to communicate is far more essential. If ambulation training so fatigues the patient that he cannot give his best efforts during speech therapy, then the entire regimen needs reviewing and adjustment. While there is no wish to downgrade the value of independent ambulation, it should be remembered that wheelchairs can provide excellent mobility. By comparison, substitutes for meaningful speech are virtually nonexistent.

FIGURE 1.—CHECKLIST OF ACTIVITIES OF DAILY LIVING (HEMIPLEGIA).

1. FEEDING
   a. self
   b. with help
   c. adaptive equipment
   d. use of knife, fork, spoon, cup
2. AMBULATION
   a. weight bearing
   b. with help
   c. use of cane, crutch, brace
   d. wheelchair
3. EXERCISE
   a. passive
   b. active
   c. active-resistive
   d. active-assistive
4. DRESSING AND HYGIENE
   a. self
   b. with help
   c. adaptive equipment
   d. teeth, shave, etc.
5. TRANSFER ACTIVITIES
   a. bed to w. c.
   b. w. c. to bed
   c. commode
   d. lock w. c.
   e. use of chair
6. BATH
   a. self
   b. with help
   c. adaptive equipment
   d. tub, shower, room
7. POSITIONING
   a. in bed
   b. in w. c.
   c. in chair
   d. dependent
8. INCIDENTAL HAND ACTIVITIES
   (*doors, writing, windows, etc.*)
   a. self
   b. with help
   c. adaptive equipment

Rehabilitation jargon refers to the rudiments of personal independence as Activities of Daily Living (ADL). There are more than a hundred of these items which most healthy people perform every day almost subconsciously. Figure 1 is a duplicate of the ADL checklist used by the authors' department to record functional progress of stroke patients during rehabilitation. More extensive listings are available, but the items included here are thought to be the most critical.

Control of Bladder and Bowel

Most stroke patients have a degree of urinary and fecal incontinence during the initial recovery period. The aesthetic reasons for minimizing these neurogenic dysfunctions are obvious. Psychologically, the patient regards this embarrassing situation as indicative of infantile regression, and socially such complications are unacceptable. Fortunately for all concerned, both types of incontinence are usually transient, and proper management can forestall most untoward incidents.

Diminished or absent cortical inhibition is the physiological cause of urinary incontinence. This is indeed a "baby's bladder," the sensory components are intact but the brain cannot inhibit the micturition reflex. Bladder training programs are designed to make the patient aware of the sensations produced by the distending vesicle, and to assist him in achieving voluntary cortical inhibition. During the early recovery phase, or if inhibition cannot be learned, it is necessary to set up a "timed-voiding" schedule. That is, the patient routinely urinates every 2 or 3 hours, using an alarm clock as a reminder if necessary. Thus emptying is accomplished before the distention-initiated reflex can trigger uncontrolled excretory mechanisms. Preventing overdistention by retained urine is physiologically more important than controlling incontinence, and an indwelling catheter may be indicated during the first few days of illness. Chronic stretching of the detrusor muscle within the bladder wall may result in permanent loss of contractility.

Bowel disturbances in the stroke patient are usually transient and readily controlled. The combined factors of neurogenic shock, inactivity, and diminished intake of food and fluids result in a generalized decrease of peristalsis and sphincter tonus. If constipation is prolonged, fecal material accumulates in the sigmoid

colon and becomes impacted. Eventually, the more fluid contents of the bowel bypass the fecal impaction and atonic sphincter; these liquefied stools cannot be consciously controlled by the patient, and thus a type of fecal incontinence is present. This finding should not be mistaken for true diarrhea.

The best treatment is prevention. Adequate hydration and bulk foods are usually sufficient, although limited oral intake of stool softening compounds is sometimes indicated. Persistent difficulties with bowel evacuation have been shown to respond readily to control with medications, such as Bisacodyl, which stimulate peristalsis by direct contact with the bowel wall (Wolcott, 1963). This type of management is physiologic, and superior to the usual laxatives, enemas, digital extractions, and similar routines.

Prognosis of Functional Recovery

The preceding 5 basic principles are general guides for a restorative program following stroke. Throughout convalescence and rehabilitation, one question is uppermost in the minds of the family, the patient and attending staff: What will be the type and amount of permanent impairment? Making definite prognostic statements, as physicians well know, is especially treacherous in this type of pathology. Each doctor frames his answer according to the particular circumstances and his personal judgment. Any reliable statistical data is also weighed in attempts to derive a reasonable prognosis.

The most reliable prognostic statement about functional recovery is this: The milder the specific impairment and the quicker it shows evidence of returning to a normal state, the better the prognosis for diminution of that particular impairment. For example, if the patient with severe expressive aphasia regains some speech function during the first week or so, his chances are good for recovering most of the lost ability to talk. Similarly, we know that early weight-bearing on a paretic lower extremity often produces some voluntary motion of that leg, which in turn suggests a favorable prognosis in regard to eventual ambulation. Time-function patterns of upper extremity recovery have also been investigated (Bard and Hirschberg, 1965). Stroke, like any other pathological condition, is subject to one infallible prognostic rule which is disguised by statistics; that is, if 99 of 100 patients will predictably survive a given condition, the sole fatality is, invariably, 100 percent dead.

Rehabilitative Medical Management

The rehabilitative medical management of the stroke patient evolves through rather distinct phases. The following presentation of specific restorative measures for the *hemiplegic with aphasia*, includes 4 phases: acute, postacute, convalescent, and period of followup care. These measures are primarily rehabilitative in nature, and it is assumed that more routine medical items are already prescribed.

Acute Phase

1. High protein diet. (This means a minimum of 90 grams daily. Consistency of food is adjusted to the patient's ability to swallow without aspirating.)
2. Turning and repositioning patient in bed every 2 hours. (On the involved side, the arm is flexed at about 90 degrees, and the lower extremity is positioned in extension and neutral rotation with small sandbags.)
3. Close observation of skin for areas of potential ischemia. (Persistent redness at any place should be freed of all possible pressure.)
4. Indwelling Foley catheter.
5. Irrigation of bladder twice daily with 250 cc of ¼% acetic acid solution. (The entire 250 cc volume is introduced and retained before emptying is permitted. This maintains normal bladder capacity and tonus. If necessary, the solution can be approximated by mixing 1 tablespoon of vinegar in 1 quart of water.)
6. Deep breathing exercises 3 times daily, under supervision.
7. Observation for evidence of fecal impaction.
8. Bisacodyl 5 to 10 milligrams orally at 6 p.m. daily, and rectal suppository at 8 a.m. daily or as necessary.
9. Carbon dioxide inhalation therapy for 15 minutes 4 times daily. (Positive pressure apparatus mixture may deliver either (a) 5% CO_2 and 95% air, or (b) 5% CO_2 and 95% oxygen.)
10. Passive range of motion exercises of all joints of involved extremities once daily.
11. Active resistive range of motion exercises of all *un*involved joints and trunk, once daily.
12. Early evaluation by speech pathologist for planning and determination of satisfactory communication techniques.
13. Early case evaluation by social worker when member of family is available.

The above regimen is directed primarily toward the

prevention of iatrogenic and other complications. As the patient's condition stabilizes and general improvement is evident, certain changes in his restorative program are necessary.

Postacute Phase

1. Sitting on edge of bed to tolerance 3 times daily.
2. Beginning instruction in self-care activities.
3. Attachment of half siderail to bed on side opposite the paretic extremities for use by patient in coming to a sitting position.
4. Avoidance of "gatching" the bed.
5. Removal of indwelling catheter and instruction of patient in use of timed-voiding schedule.
6. Speech therapy begun as indicated by speech pathologist.
7. Evaluation by recreation therapist.
8. Evaluation by vocational counselor, if indicated.

The benefits of such early restorative measures are soon apparent. After about 2 weeks, the patient's exercise tolerance is usually sufficiently improved to permit sitting upright at the edge of the bed for an hour or more without undue fatigue. At this stage, transportation to other departments by wheelchair is possible, and the restorative efforts are again revised.

Convalescent Phase

1. Support of involved upper extremity by sling except when lying down. (The arm is flexed across the chest at about 100 degrees and in neutral rotation. Greatest support is maintained at the elbow and hand. Without such support, the weight of the paralyzed arm cannot be adequately resisted by the flaccid shoulder muscles, and glenohumeral distraction results. This position also permits some dexterous manipulation with the paretic hand acting as the opposing force.)
2. Sitting in chair to tolerance when desired.
3. Mandatory one-hour siesta after lunch.
4. Bed may be "gatched" for short periods in evening.
5. Other measures include physical therapy activities:

(a) Progress as indicated from tilt table to balancing between parallel bars, and then to ambulation with assistance. (Rate of progression during the initial days and weeks will depend upon patient's general exercise tolerance, functional return in paretic extremities and, of course, his motivation.)

(b) Beginning training program designed specifically for the involved musculature, primarily by use of *active assistive* range of motion exercise program.

(c) Beginning training in techniques of *independent transfer.* (This involves simple methods developed for a hemiplegic person to transfer himself from one position to another without aid. Movement in both directions is taught, and some examples include: bed to wheelchair, bed to ordinary chair, wheelchair to bathtub, wheelchair to auto, and many other situations encountered in daily living.

6. Short double-upright brace on paretic lower leg with assistive spring dorsiflexion ankle joint.
7. Additional measures by occupational therapy:

(a) Training in pertinent problem areas in activities of daily living. (ADL program should be prescribed to: (1) facilitate immediate needs to carry out personal care; and (2) to enhance neuromuscular and perceptive integration of functions.)

(b) Encouragement of use of paretic arm while supported in sling.

(c) Provision of needed adaptive devices and training of patient in their use.

8. Recreation therapy program as indicated by consulting therapist.
9. Active vocational counseling, if indicated.

Eventually a point is reached in the patient's recovery when he no longer requires hospitalization. His particular circumstances will dictate whether discharge will be to an extended care facility, a nursing home, his own residence, or to some other environment.

The preceding measures have outlined optimum restorative therapy during the acute, postacute, and the convalescent phases. The rehabilitative program is now at its fourth stage, the period of functional polishing.

Followup Phase

1. The provision of information essential to the patient's continuing improvement and wellbeing for family or personnel at receiving facility, and the listing in writing of essential restorative practices that will need to be carried on by family or others after discharge.
2. Continue speech therapy through nearby facilities as indicated.
3. Followup in 1 month for reevaluation by physician and appropriate other staff personnel.

There is little else to add to this restorative regimen without belaboring the superficial, the superfluous, or the redundant. Only the rare stroke patient recovers completely without any neurologic impairment. Conse-

quently, most of these rehabilitated individuals will still benefit from intermittent followup evaluations. Such reevaluations are considered to be prophylactic measures that should become routine.

Later secondary complications and increased disability, when present, are almost invariably the result of neglect. Some of the more common problems are obesity, increased cardiovascular insufficiency, muscle atrophy, contractures with joint deformities, and frequently, disturbances of vision. Also, the very real danger of drifting gradually toward the emotional state of pseudosenility (which has been described) cannot be overemphasized as a preventable tragedy. It is the worst hypocrisy to save this life, restore it to reasonable function, and then to allow the object of that effort to degenerate through ambient indifference.

Arthritis and Related Conditions

Rheumatoid Arthritis

This is a chronic systemic disease in which the visible manifestations appear mainly in the distal joints. Nonspecific pathological changes are found in the synovium, periarticular cartilage, and in skeletal muscle. Clinically, there are periods of painful inflammatory-like exacerbations, followed by periods of remissive inactivity. Joint pain and joint deformity are the two major disabling sequelae.

Precise figures on incidence and prevalence are impossible to obtain. Statistical estimates derived from carefully documented case findings indicate, however, that the incidence is about 20 cases per 1,000 persons over age 15 in the United States (Clark, 1965). These cases were defined according to the criteria outlined by the American Rheumatism Association. Rheumatoid arthritis affects females more frequently than males, with reported ratios ranging from 2:1 to 9:1. The disease may begin at any age, but most often occurs between 20 and 50. A rapidly developing form in children is known as Still's disease. The etiology of rheumatoid arthritis is unknown. Two primary theories suggest the cause to be either: (a) an infectious process, probably viral; or (b) an auto-immune reaction in which the body's immune mechanisms become deranged.

The clinical picture of advanced rheumatoid arthritis is generally one of a multiphasic development. The affected joints are more comfortable at rest with the capsule relaxed in the position of flexion. Disuse atrophy of adjacent muscles occurs and the normal imbalance of flexors over extensors is accentuated. Muscle guarding to prevent pain and muscle spasm secondary to pain may contribute further to abnormal tension about the involved joint. Significant force is also exerted by gravity and postural abnormalities. Within the affected joint, the resulting pannus (abnormal excrescences of synovium) permanently damages the articular cartilage, distorts normal relationships, and increases susceptibility to further trauma. The end result of these processes is severe deformity.

Flexion contractures of muscles are common early deformities resulting from disuse, lack of normal tension from opposing muscles, and the abnormal attitude of the joint. Abnormal muscle tension and joint deformities combine to produce malalignment of tendons. This results in subluxation, tendon rupture, or ankylosis.

Specific deformities.—Many specific deformities occur in advanced rheumatoid arthritis which produce varying degrees of disability. In the *hands,* interphalangeal joints are usually hyperextended and metacarpophalangeal and *wrist* joints are flexed and in ulnar deviation ("swan's neck" position). The *forearm* may be fixed in pronation with flexion deformity existing at the elbow. The *shoulder* will often be limited in abduction, flexion, and external rotation. With the commonly associated impairment of scapular rotation, scapulohumeral function is seriously disturbed.

In the *feet,* the toes may deviate laterally and the metatarsophalangeal joints are often hyperextended due to tendon contractures. Inversion and eversion of the foot may be limited and foot-drop is quite common. The *knee* may be limited in both flexion and extension with atrophy of the vastus medialis muscle, which functions primarily in providing terminal extension of the knee.

Flexion, abduction, and external rotation contractures of the *hip* are not uncommon but this is usually secondary to prolonged maintenance of the sitting position.

Prognosis.—This is extremely variable and depends upon such factors as severity of the disease, adequacy of treatment, and management in the restorative program. With appropriate comprehensive care, including surgery when indicated, the prognosis improves and prevention or reversal of crippling deformities can often be accomplished.

There is ample reason to consider the deformities evident in most rheumatoid patients as complications which were once potentially preventable. At least this medical hypothesis is not unrealistic. Any early signs

or symptoms should therefore be vigorously treated to prevent possible later deformities. Application of this philosophy has everything to gain and nothing to lose.

Rheumatoid restorative programs.—The basic program in rheumatoid arthritis is aimed at relief of fear, fatigue, stiffness and pain, suppression of the inflammatory process, and prevention or correction of deformity. This program can be divided into psychological, pharmacological, physical, and surgical measures. While a specific patient may require greater emphasis in one particular area, success of the rehabilitation program depends upon proper attention to all 4 of these therapeutic modalities.

Psychological aspects.—One must approach management of the geriatric patient having rheumatoid arthritis with knowledge and concern for the psychological factors which may be present in the patient, his family, and even the physician (Moos, 1964). Even though the course of this disease is unpredictable, the patient often progresses toward increased disability and dependency. He becomes fearful and confused due to conflicting information from many sources, and is quite susceptible to fads and quackery. He also becomes highly manipulative.

The patient frequently changes physicians and is apt to be inconsistent in followup visits. A variety of treatments will be suggested by friends, relatives, news media, and faithhealers, which may displace effective therapy. Due to the frequency of spontaneous remission, healing power may be erroneously ascribed to a variety of spurious agents. The patient requires much more of the busy physician's time to counteract these influences and on occasion, he may even question the rationale of the therapeutic regimen. This frequently frustrates and irritates the physician.

The physician should explain the nature of rheumatoid arthritis and the need for the patient to cooperate in its management. The family members should be included in the long-range program to a degree consistent with their attitudes and intelligence. Detrimental attitudes should be explored and fears allayed whenever possible.

Bedrest.—Adequate rest should include 8 to 10 hours of sleep each night, induced with mild sedation if necessary, as well as 2 one-hour rest periods each day in severe cases. Proper positioning on a firm mattress with the joints in mild extension is essential. A flat pillow beneath the head and appropriate lateral supports are indicated. Pillows are *not* placed under the knees. A vertical footboard is used to prevent heelcord contractures. Bedding is never tucked in nor should it be allowed to press against the feet, since this is the most common cause of severe plantar flexion deformities. When a footboard is used, bedding is placed *over* it. In its absence, an arching cradle frame is placed between the feet and the heavy bedding.

Diet.—A balanced diet containing adequate amounts of protein, minerals, and vitamins is necessary. The patient is told that no foods are known to specifically benefit or hinder the disease. If the temporomandibular joints are involved, a soft diet is prescribed and special attention is required to maintain nutritional adequacy.

Adaptive devices.—The patient requires a chair of suitable height with a firmly padded raised seat and arm rests to assist him in rising and sitting. Shoes should be comfortable and provide adequate support. A low broad-heeled oxford with a high vamp and laces is generally most practical. Corrective devices such as metatarsal bars, pads, heel wedges and lifts, and rigid arch supports are indicated in many instances. A variety of self-help devices are available commercially. For example, eating and grooming devices with larger or longer handles may compensate for decreased grip or range of motion. Elevated toilet seats, either permanent or removable, are available, and handy grab bars on the walls and bathtub may be installed.

Therapeutic physical modalities.—The primary physical means of treating arthritis are splints, heat, and therapeutic exercise. Massage has not been found to be helpful except to relieve occasional muscle spasm.

Splinting.—Splints are used therapeutically for immobilization, to provide rest and protection during periods of acute inflammation, to correct deformity, and to assist weak muscle groups. Ideally all splints for rheumatoid joints should be lightweight, removable, and comfortable. Acutely inflamed joints are immobilized except for 1 or 2 short periods during the day when the splint is removed for range of motion exercises. Joints are placed in the position of function when splinted. In the hand and wrist this involves 20 degrees of hyperextension of the wrist, with the fingers flexed slightly at all 3 joints. Ulnar deviation of both the wrist and fingers should be prevented. The thumbs are kept in moderate abduction. Only the affected parts of the hand are immobilized with other joints left free to function normally. The same attention is paid to functional positioning of all other joints. Corrective splints may be spring-loaded or be modified regularly

to gradually lengthen contracted tendons and muscles. Assistive splints are commonly used for ulnar drift of the fingers and other manifestations of abnormal muscle pull. This type of splint allows the patient to continue to use the joint while it is maintained in the proper position.

Heat.—While heat does not alter the underlying disease process, it is very beneficial in relieving pain and facilitating exercise procedures. Appropriate caution against the danger of burns is essential. This is particularly true if the patient prepares the material himself, since an unsteady grip may result in dangerous spills of hot liquids. The length of application should not exceed 30 minutes or stiffening of the joint will occur. The patient should be warned against falling asleep while using infrared or radiant heat lamps and bakers, which are generally applied 30 inches away from the area being treated. Sun lamps should not be used. Hot packs can be made of towels heated to 110 degrees in water. Hydrocollator packs may be used which contain silica gel heated to 170 degrees in hot water, but must be applied to joints covered with at least 6 layers of dry toweling. A 30-minute hot tub bath at 100 degrees is a very satisfactory method of heating, provided the tub is equipped with safety features.

The paraffin bath or dip is an ideal heating modality for hands and feet. One ounce of mineral oil is added to each pound of paraffin to reduce its tendency to dry the skin and adhere to hair. This method can be used at home very easily by heating the paraffin in a double boiler. Since burns are quite apt to occur if the temperature rises above 126 degrees, paraffin with a melting point below this temperature must be used. Temperature can be checked with a cooking thermometer. The hands are then either immersed for 10 to 15 minutes or intermittently dipped and removed, causing a film of paraffin to form during cooling. After 30 minutes the paraffin can be peeled off and reused.

Contrast baths.—Contrast baths are used to treat hands or feet by immersion in water of 105° F for 4 minutes, and then immersing affected limbs in water at 65° F for 1 minute. This routine of alternating baths is continued for a total of 24 minutes, beginning and finishing with a hot bath.

Nonbeneficial modalities.—Thermal pads are discouraged because of the non-uniform distribution of heat. Diathermy and ultrasound offer no particular advantage. There is no conclusive evidence that applications of electricity, magnetic forces or low-energy radioisotopes are therapeutically effective. Increasing knowledge about certain related biophysical interactions with these agents may, however, eventually indicate an acceptable rationale where none now exists.

Exercise.—Exercise is an essential part of the basic program and is the chief means of preventing deformity and muscle atrophy. The initial evaluation of the patient with arthritis should include a complete joint examination, range of motion determinations, and testing for muscular weakness. The exercise program is formulated on the basis of these findings. Results of the program are recorded serially to determine the progress of treatment. An over-ambitious program may so overwhelm the patient that he does no exercises at all, or becomes so fatigued that normal function is impaired. Commonly, analgesics and heat are prescribed prior to exercise.

Both passive and active exercises are used. The active exercise program may be either isometric or isotonic. The minimum program for prevention of deformity in affected joints is a *passive* movement through the entire range of motion given at least twice a day. Since loss of range begins at the extremes of motion, mild stretching is indicated if such loss has occurred. Isometric exercises are presented to prevent atrophy of muscle adjacent to immobilized joints, and these should be repeated 10 times each day. Such exercises are especially important for the knee and hip extensors, which are vital to future ambulation.

When deficiencies in muscle strength and joint limitation occur, and if immobilization is not required, *active exercises* with some assistance are prescribed. If signs of increased pain or stiffness appear, exercises are decreased accordingly. Although many specific techniques to strengthen deficient muscles are known, it is best to limit the number to no more than 5 or 6 per session. For a home program, lists of exercises and illustrated booklets are available (Arthritis and Rheumatism Foundation, 1958 (a)), but these must be accompanied by explicit instructions.

Surgical restoration.—Surgical restoration in rheumatoid arthritis includes a number of orthopedic procedures. The usual indications for surgery are impending or existing functional disabilities which do not respond to appropriate conservative measures. Results have been increasingly satisfactory as more clinical studies have been carried out in this area, and newer and better procedures are being developed. The selection of patients for surgery should be a cooperative process involving the orthopedist, physiatrist, rheumatologist and the patient. Pain is not an indication for

surgery. Generally speaking, surgery does not affect the active inflammatory phase of this disease, and thus such activity is not a surgical contraindication. For optimum results, surgery is performed as soon as disabling complications appear or are anticipated.

It is imperative that an appropriate program of physical and occupational therapy accompany the surgical treatment. The most important portion of this program is *postoperative exercise* to insure maximum restoration of function to the affected parts. Surgical restorative care for arthritis is aimed at correcting the pathological changes and facilitating maximum function. These surgical procedures usually involve the removal of proliferating synovium and granulation tissue which are distorting normal relationships in the joint. These procedures may also involve repair or relocation of ligaments and tendons. Bony elements may be removed or fused, and in some cases prosthetic devices are substituted for damaged joint structures.

Rheumatoid arthritis in conclusion.—It is evident that the successful management of the restorative program in rheumatoid arthritis involves many medical specialties and many allied health care disciplines. Constant evaluation by this multidisciplinary team, whose goal is to maintain the patient's maximum function, will do much to prevent regression in a grateful individual.

Degenerative Joint Disease (Osteoarthritis)

This is a degenerative condition of inexact etiology and no systemic involvement. It affects only the joints, particularly those weightbearing areas such as the knees, hips, lumbar and cervical spine. There is no inflammatory component as suggested by the terminal "-itis"; thus the condition is not truly a type of arthritis.

Degenerative joint disease is virtually universal in persons over the ages of 40 or 50. The one known contributing factor is trauma. This may be due to abnormal stress, such as that resulting from skeletal deformities or repeated injury to a specific joint area. Examples of this latter include the "jackhammer wrist" in which the metacarpal joints of hydraulic jackhammer operators are affected, or the similar condition often seen in the glove hand of major league baseball catchers.

Grossly, there is roentgenologic evidence of diminished joint spaces, periarticular demineralization, and typical hypertrophic spurs of bone projecting from the adjacent lips of a joint. The basic mechanism is a gradual destruction of intra-articular hyaline cartilage which brings the bony surfaces into close apposition. The periarticular soft tissues are not involved, although secondary muscle disuse atrophy may result from prolonged pain. Unlike rheumatoid arthritis, the pain of degenerative joint disease is worse *after* exercise.

A peculiar, pathognomic finding is a permanent painless swelling of the terminal interphalangeal joints of the fingers (Herberden's nodes). Concomitant mushrooming of the distal end of the involved phalanx is seen on X-ray, and spurring usually underlies the fibrous node itself.

Pain in the affected weightbearing joint is the major clinical symptom, and is thought to be due to disturbance of the adjacent skeletal periosteum. Since about one-half of cases have spinal involvement and about one-third have affected knees or hips, the resulting disability in the older population is considerable. Pain is often referred to nearby areas of soft tissue, and this enhances the degree of disability by subsequent development of generalized weakness and debility.

Psychological aspects.—It is essential that the patient understand the nature and prognosis of degenerative joint disease. Usually called osteoarthritis, the term often conjures up the frightening image associated with severe deforming rheumatoid arthritis. He should be assured that the condition is relatively nonprogressive, is unlikely to "spread" to other joints, and that it need not result in severe crippling deformities and debility (Arthritis and Rheumatism Foundation, 1958 (b)). It would be a kindness if the word "osteoarthritis" were abandoned completely since it is both a misnomer and a source of unnecessary anxiety.

Specific areas of involvement.—In the *knee* the structures involved are the posterior surface of the patella and the opposing surfaces of the distal femur and proximal tibia. The disease is more apt to be severe if the individual had preexisting genu varus or genu valgus. These bowlegged or knock-kneed people tend to have inherent joint instability that creates abnormal mechanical stresses. Even minimal limitation of knee extension may cause weakness and atrophy of the quadriceps muscle.

Degenerative changes in the *hip* are usually the most disabling form of this condition. Initial pain often occurs along the distribution of the obturator, sciatic, or anterior crural nerves. It is accentuated during weightbearing. Occasionally, this referred pain is so intense at the medial surface of the knee that attention

is mistakenly directed to that area. Hip movements may show marked limitation. Extension, abduction and internal rotation are reduced and the patient characteristically holds the hip flexed, adducted and externally rotated. The gait is typically antalgic (pain-reducing) when hip involvement is severe.

Disturbances due to hypertropic changes in the *neck* are discussed in the following section on cervical spondylosis.

Rehabilitative measures.—An adequate restorative program can retard progress of the condition, prevent significant deformity, and do much to relieve pain and general discomfort. The patient's need for explicit prognostic information and emotional support has already been discussed. Adequate *rest* is essential (as it is in rheumatoid arthritis), but moderate activity is encouraged in order to maintain physiological functions. Unnecessary or prolonged weightbearing on affected joints is contraindicated. Suitable canes or crutches are prescribed to reduce gravitational forces when knees or hips are affected.

A reducing diet is mandatory for obese individuals with involvement of the weightbearing joints. This usually causes diminution of pain and retards the destructive process.

Local application of heat is often helpful in the relief of pain and acute muscle spasm. Moist heated towels are recommended for large areas. For treatment of hands or feet, paraffin dips are most beneficial.

Specific exercises are prescribed with judicious care. For obvious reasons, maneuvers which require unusual joint stress (e.g., weightbearing) are to be avoided. Brief intermittent periods of passive, active assistive, and active resistive exercises will increase joint mobility and muscle strength.

Surgery related to degenerative joint disease is divided into two types: (a) preventive, carried out by correction of predisposing congenital or acquired deformities (e.g., certain dysplasias, intraarticular fractures, coxa plana, aseptic necrosis, epiphysitis, osteochondritis); and more often (b) restructuring of joints to relieve pain or restore function (e.g., patellar excision, subtrochanteric osteotomy of femoral head, contracted capsular incision, hip prosthesis or cup arthroplasty).

Degenerative joint disease in conclusion.—The ubiquitous prevalence of this condition among the aged is in sharp contrast to the meagerness of known effective countermeasures. With a few exceptions, therapy is mainly palliative or supportive.

Supportive therapy, in this instance, refers to the imperative need to allay the patient's fears regarding his ultimate prognosis. To repeat, the diagnosis of "arthritis" is usually considered by laymen as synonymous with rheumatoid arthritis and its common associated deformities. This erroneous conception of degenerative joint disease should therefore be extinguished by the attending physician. We know of no better starting place than to repress osteoarthritis and hypertrophic arthritis from our conscious medical vocabulary. Philology, therefore, becomes an effective therapeutic tool in a resistant condition.

Cervical Spondylosis

Degenerative disk disease in the cervical spine is a continuous progressive process beginning at the age of maturity. As the disease progresses, hyperostosis occurs at the margins of the vertebral bodies and particularly at Luschka's joint. Disabling neurological involvement may develop.

Specific sequelae.—The resulting encroachment on the intervertebral foramina produces a *radiculitis* of varying severity which may be unilateral and may be confused with a ruptured intervertebral disk. One or more nerve roots may be involved, depending on the extent of the process.

Hypertrophic spurring at the posterior margins of the vertebral bodies with encroachment on the spinal canal may produce compression of the anterior spinal artery and/or the anterior portion of the spinal cord. Even minimal spurring when the neck is flexed results in paresthesias below this level (Lhermitte's Sign). Thrombosis may ensue and cause permanent central cord damage.

Spur formation, particularly between C–6 and the foramen magnum, can produce the rare vertebral artery syndrome (Pallis et al, 1954; Reivich et al., 1961). When the head is extended and rotated laterally, the contralateral vertebral artery is compressed by hypertrophic growths. This produces transient symptoms resembling basilar artery involvement (e.g., diplopia, collapse, nystagmas, paresthesias). Occasionally, vertebral artery thrombosis is the sequel to this phenomenon (Reivich et al., 1961).

Injury to the neck, especially the whiplash mechanism, is often the event which precipitates neurologic damage from a preexisting spondylosis. In view of the serious nature of the neurologic or vascular involvement which may occur in the neck, efforts to prevent undue stress and injury are indicated.

Sudden movements of the neck to the extremes in any of the planes of motion should be avoided. The patient should develop the habit of rotating his body to minimize head movement.

Restorative considerations.—The restorative care of patients with cervical spondylosis is outlined below.

Rest.—Rest during the acute phase. (This means off their feet for a majority of the time, proper positioning in bed, and analgesics to promote relaxation and effective rest.)

Immobilization.—To immobilize the neck, use sand bags in bed, high wrap-around felt collars, or plastic laminate neck braces. These prevent rotation, hyperextension and hyperflexion, and lateral flexion. The plastic, button-on collar is inadequate since it will only prevent hyperflexion.

Physical therapy.—Moist heat and ultrasound should be used to enhance analgesia and produce significant muscle relaxation, and this should be followed by manual traction and gentle passive range of motion. As the acute process subsides, head-halter traction is added (not substituted for manual traction and range of motion). The weight is determined by relief of symptoms (usually 30 to 45 pounds being necessary). The neck is positioned in about 20 degrees of flexion, and the axis of tension must be parallel to the cervical column. When optimum range and relief of muscle spasm are obtained, strengthening exercises to the posterior, lateral, and anterior neck musculature should be initiated.

Surgery.—Surgical procedures may be necessary to relieve nerve root or cord compression and to immobilize the cervical spine more effectively.

Cervical spondylosis in conclusion.—A maintenance program involving all of the above therapeutic measures may be necessary to prevent recurrence of disability. The patient can be instructed in such things as bed positioning, type of pillow, self-applied cervical traction, use of appropriate neck support, medication, and other preventive measures.

Lower Extremity Amputation

While most categorical "geriatric problems" are considered to begin in accordance with the previous definition of "aged," a national research conference on the amputee in 1961 designated the geriatric amputee as 55 years of age and above. This arbitrary designation ignores the discrepancies between chronological and physiological age. Consequently, undue emphasis is placed on chronological age as a major criterion for the type of prosthesis prescribed.

Regardless of the grouping, continued medical supervision of the amputee's rehabilitation program is essential. It is unfortunate when a prosthetic salesman, or even a prosthetist, is allowed to manage this regimen. Rather, a competent physician must carefully guide the geriatric amputee program through its various phases.

Preprosthetic Essentials

Whenever possible, counseling of the patient about the rehabilitation program in which he will be expected to participate must be done. Exercises to maintain range of motion at the hip and knee should be initiated and a general physical conditioning program be instituted at this time which, in many instances, will include gait training with crutches.

The conventional method of stump conditioning by wrapping with an elastic bandage produces satisfactory shrinkage in the majority of patients. In others, the added use of the pneumatic boot or an intermittent compression unit is required to reduce edema. Occasionally, serial plaster casts with the incorporation of a pylon are necessary. This phase of the program also includes maintenance of range of motion in the hip and knee, and strengthening exercises for the functioning stump musculature.

Existing contractures are treated intensively. Both prosthetic and postprosthetic management are greatly complicated by inability to extend the hip and/or the knee. Connective tissue exhibits prompt and progressive shortening when the opposing force is inactive for even short periods of time. Recent studies indicate that connective tissue has a very high tensile resistance to sudden application of tension such as occurs during intense muscle activity (Kottke et al., 1966). Despite the absence of elastic fibers, this collagenous tissue has the property of plasticity which allows gradual elongation during moderate, constant tension. Thus, a prolonged stretching technique with moderate force is more successful than a great force applied for a short period of time.

The rapidly developing technique of immediate postsurgical fitting in both the above- and below-knee amputee may well obviate the need for a formal preprosthetic program (Burgess et al., 1967). The short clinical experience with this method of amputee management has been very rewarding. It is especially applicable to the geriatric amputee in that it minimizes

the period of forced inactivity and prevents the sequelae of bedrest.

The cast which is applied to the fresh stump on the operating table is patellar tendon-bearing in the below-knee amputee and ischial weightbearing in the above-knee amputee. A pylon is attached on which the patient may walk within 24 hours. The pylon is removed when the patient is in bed to prevent skin breakdown from pressure. It is then reattached for short periods during initial gait training. The prevention of edema hastens the healing process, and early mobilization maintains exercise tolerance and balance. Because the stump shrinks very rapidly with the total-contact plaster socket, frequent refitting is required. With this technique, final fitting is possible at least one month earlier than when management is traditional. Further development of this technique should minimize many of the problems encountered in the geriatric amputee.

Prosthetic Essentials

The criteria for prosthetic replacement depends upon several factors. These include: (a) general medical condition, (b) circulation, (c) balance, (d) strength, (e) contractures, (f) motivation, (g) previous athletic experience, (h) level of amputation, and (i) goals of rehabilitation. The latter is subdivided to indicate the levels of restorative potential in the following manner: (1) full restoration, (2) partial restoration, (3) self-care plus, (4) self-care minus, and (5) cosmetic plus.

It should be recognized that these factors are only guides to the decision regarding prosthetic replacement. Clinical evaluation will be more accurate if each item is carefully considered.

In regard to goals of rehabilitation, full restoration indicates an essentially nondisabled individual who can perform his job without restriction and enjoy a relatively unrestricted social life. Partial restoration, on the other hand, indicates complete productive independence, but may require a new job or job modification. Self-care plus applies to those individuals who can care for their personal needs and possibly be somewhat productive. They can function well in the home and carry out their responsibilities within the family structure. Self-care minus indicates a need for assistance in some of the functional activities such as climbing stairs and walking on rough ground or driving the car. Many individuals in this class function well enough with an adequate prosthesis to allow them to be cared for at home without particular effort. Cosmetic-plus is unrelated to the functional adequacy of the prosthesis, but refers to the significant psychological benefit derived from the appearance of having two normal lower extremities.

The prosthetic prescription depends upon the level of amputation.

Below-knee prostheses.—There is little disagreement concerning the prescription of the patellar tendon-bearing, total-contact socket, B/K prosthesis for the elderly below-knee amputee. The added stability provided by the recently developed supracondylar socket has further enhanced the favorable functional results obtained through the use of this prosthesis.

Above-knee prostheses.—There is general acceptance of the advantages of the total-contact above-knee plastic socket with suction suspension over the conventional wood, open-end socket with pelvic belt suspension. The technique of fitting and fabrication of the total-contact socket are now taught by the prosthetic schools as standard practice. Numerous investigations have demonstrated better proprioceptive input, avoidance of most previously disabling stump conditions, and a decrease in the energy cost of ambulation (Peizer, 1961). Quality of gait is improved with suction suspension in contrast to the gait made possible by the rigid, single-axis hip joint suspension with pelvic belt. The total prosthetic management of any patient is better approached with the intention of fulfilling the best medical and biomechanical principles regardless of age.

The proponents of the non-total-contact socket with pelvic belt suspension, base their opinion on the difficulty of maintaining total contact and suction in this age group. In addition, they frequently mention the excessive energy requirements and the undesirable position required to apply the socket.

In our experience, age is not a valid criterion of the type of socket and suspension to be prescribed (Schell and Wolcott, 1967). The successful fitting of the older above-knee amputee with the total-contact suction socket requires an experienced team of physicians, prosthetists, and therapists of better than average ability. Failure indicates a suboptimal performance of the attending personnel in preprosthetic, prosthetic, and postprosthetic management.

The hydra-cadence knee-ankle unit which has a cadence control and the feature of automatic dorsiflexion of the ankle with knee flexion is a very desirable

feature. The avoidance of toe-drag provides a very important safety factor.

Successful use of the suction suspension device depends on the use of 3 essential, seldom-used procedures. These are:

1. *Use of the preliminary perforated check socket* to assure accuracy of fit. With the patient's stump weight-bearing in the perforated socket, the prosthetist is able to determine the areas of improper tension and may make needed corrections in the "male" cast. With appropriate radiographic techniques, the presence or absence of total contact can be determined in the rough socket just prior to finishing.

2. *Preliminary gait training on adjustable leg.* Since it is essential to obtain accurate dynamic alignment prior to duplication and finishing of the permanent prosthesis, this phase of the program is essential. Accurate dynamic alignment is possible only as the patient becomes somewhat proficient in balancing and walking.

3. *Expert training in socket application.* The most important criterion for the prescription of suction suspension is the ability of the rehabilitation team to teach the patient to apply the socket properly and with ease.

Postprosthetic Program.

During this phase of the amputee's rehabilitation program he must achieve balance and learn to ambulate safely. (Assistive aids are prescribed as indicated.) He also learns to ascend and descend stairs and to walk on rough ground and ramps.

A major effort in this final portion of the restorative program is devoted to teaching the patient to apply his prosthesis in the correct manner. As a result of this emphasis, little difficulty will be experienced in maintaining dependable suspension by suction. In some instances, however, it may be necessary to add other suspension devices; rarely, reliance on suction must be abandoned altogether. Should suction suspension prove to be inadequate or unreliable, total contact between stump and socket must nevertheless be maintained.

Vocational counseling, special training and job placement should be provided when indicated. Comfort, function, and appearance are considered (in that order) during the final checkout by the clinic team. The interest of the team in continuing to manage the patient's problem is made clearly evident to him, and the need for regular followup evaluation is emphasized.

Lower extremity amputation in conclusion.—Most geriatric above-knee amputees can be fitted with the prosthesis which provides optimum functional assistance. The only unequivocal contraindications to the use of the total-contact, quadrilateral socket with suction suspension are: (a) the inability of the members of the clinic team to provide optimum service; or (b) the inability of the patient to complete the training program.

The successful rehabilitation of the older above-knee amputee depends upon the following items: (a) preamputation counseling and physical conditioning; (b) intensive program of stump preparation; (c) routine use of a check-socket; (d) frequent socket revisions to maintain suction and total contact during training; (e) emphasis on techniques of applying the socket; and (f) provision of ambulatory aids needed for patient's feeling of security.

It is felt that the geriatric above-knee amputee can apply a suction socket with less energy expenditure than he would use in applying the conventional socket with pelvic belt. However, this presupposes adequate rehabilitative training and use of appropriate assistive devices.

The widespread tendency to withhold more biomechanically adequate prostheses from the older age group is deplorable. Proper management of the geriatric amputee supports the concept of fulfilling the best medical and biomechanical criteria regardless of chronological age. Problems which arise, as they will in any population, can usually be solved by the coordinated efforts of team members and the patient.

CONCLUSION

In this chapter, the attempt has been made to provide a basic understanding of rehabilitation and the aged person, to explain facilities and personnel available, and to provide restorative guidelines in four disabling conditions. Any successful rehabilitation program in this group must afford the opportunity for independence and the return of self-respect; actually, it would be more appropriate to say that we must not deny these persons the opportunity to provide the necessities for themselves. Many factors, seemingly beyond the control of health care professionals, produce disability in the aged. While it is recognized that the terms *aged*, *chronic disease*, and *disability* are not synonymous, they nevertheless infer the same meaning. Part of the medical profession's responsibility in res-

torative care is to dispel this semantic myth and to help redirect our system toward a more humanistic approach.

In retrospect, it is apparent that two misconceptions might possibly result from the preceding discussions: first, that these various problems are mainly the afflictions of a less affluent populace; and second, that the programs suggested are too rigid, idealistic, and impractical for the physician who is not backed by a 10 million dollar complex of medical niceties. Neither misconception is justified.

For example, economist John Kenneth Galbraith (1966) succinctly penetrates the executive's plight: "After he has been measured through his lifetime by the single mindedness with which he subordinates all tastes and enjoyments to the needs of the corporation, he is then, at the age of 65, firmly retired. The habit of total commitment now having been fully established he now has nothing to do, or only what is obvious 'make-work.' Having become habituated to group activity, he is now alone. It is not a beautifully sculptored arrangement. Millions since the dawn of man have led a less inspired existence, but never on comparable income."

Obviously, individuals differ from one another in many ways, but irrespective of these differences, certain basic human needs are common to all (Werntz, 1967). They are: (a) the need for physical health; (b) the need for self-respect; (c) the need for social acceptance; (d) the need for a satisfying occupation; (e) the need for recreation; (f) the need for freedom of choice; and (g) the need for a satisfying exchange of human affection.

These universals permit us to dismiss the second possible misconception. We do not, nor does anyone else, have any pat answers to rehabilitation needs or procedures. This philosophy is clarified by the thoughts of two erudite contemporary observers who acknowledge that "there are a hundred ways to do a task correctly, but one must first know what it is all about" (Neuman and LaFleur, 1968).

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SECTION B/CLINICAL PROBLEMS CLOSELY RELATED TO MULTIPLE ORGAN SYSTEMS

Part XIV/Drugs

DRUG THERAPY IN THE AGED

By

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INTRODUCTION

Two major aspects of geriatric pharmacology are considered in this chapter: first, the effect of age on various tissues and organ systems responsible for drug disposition and handling; and second, the effect of age on the therapeutic and secondary actions of drugs.

PHARMACODYNAMIC ASPECTS OF AGING

For this discussion, the plasma level of a drug is considered to be directly related to its concentration at its site of action, and the magnitude and duration of the response is considered to be a reflection of the concentration at this site. Factors which influence the plasma level include absorption of the drug from the site of its administration, distribution within the organism, and the rate at which it is metabolized and eliminated from the body. The response to a drug is also a reflection of two other factors: first, the integrity of the receptor site; and second, the integrity of mechanisms which are responsible for maintaining the status quo of the internal environment.

Absorption

For a drug to exert an effect, it must be absorbed from the site of administration and pass across several membranes to reach its site of action. With aging, changes are thought to occur in the gastrointestinal tract, and a number of authors have suggested that drug absorption is impaired and that there is less complete absorption following oral administration.

With increasing age, there is less complete absorption of a number of substances including fat, thiamine, glucose, 3-methylglucose, iron and xylose. Impaired absorption may reflect a decrease in arterial blood flow to the gastrointestinal tract resulting from atherosclerosis, a deficiency in enzymes responsible for maintaining transport mechanisms in the gut, or a decrease in the number of active cells in the intestine.

Distribution

A drug is distributed within the organism in a manner which is related to its chemical structure. Variations in tissue composition, membrane permeability and peripheral circulation may modify distribution. It is impossible to anticipate or predict, and there are no data to indicate, what changes in drug distribution may occur in elderly individuals. In the very young, there is evidence to suggest greater permeability of the blood brain barrier, which may be responsible for the fact that many more drugs reach the central nervous system of the newborn than of the adult.

With advancing age, active and functional tissue is replaced by fat, and it is known that a number of drugs are deposited preferentially in this tissue. Thus, one might anticipate that drugs which are accumulated by fat may have a more pronounced and longer duration of effect in an older patient.

Excretion

The duration of activity of a drug is limited by the length of time it remains in the body in an active form. This period of time is influenced by the rate at which the active drug may be eliminated or the rate at which the active form is metabolized to less active or inactive metabolites.

For the most part, drugs are excreted through the kidney either as a result of passive filtration at the glomerulus or by active secretion into the filtrate. There is evidence to suggest that glomerular filtration rate and renal blood flow are reduced in the elderly patient. This may be responsible for the delayed elimi-

nation of a number of drugs and their metabolites. The active phase of secretion may also be impaired. Higher plasma drug levels are achieved in the elderly compared to younger individuals following intramuscular administration of a number of antibiotics. These compounds are eliminated primarily via renal secretion.

Drugs may also be conjugated in the liver and eliminated through the biliary tract. While some authors have suggested that the liver is less capable of clearing circulating substances in elderly individuals, there is no evidence to support this conclusion. Indeed, results of recent studies indicate that the ability of the liver to clear various substances is unimpaired with age.

Metabolism

The duration of activity of highly lipid soluble compounds is limited by the rate at which the active drug is converted to less active and less soluble metabolites. While some drugs may be metabolized by enzymes in the circulating plasma, drug metabolism occurs primarily in the liver; here microsomal enzymes are responsible for the greatest proportion of this work. Failure of these enzymes to exert an effect on a drug, as may be produced by pretreatment with drugs which inhibit their activity, is reflected in much higher blood levels and a longer duration of drug activity. Data pertaining to the effect of age on microsomal enzyme activity are limited to a very few animal studies. Results available suggest that in the very old animal there is a decrease in enzyme activity which is reflected in higher plasma and tissue drug levels. There is also a deficiency in microsomal enzyme activity in the newborn, but this is corrected within a short period of time after birth. There is also evidence indicating that in man and in animals there is a decrease in the activity of circulating enzymes such as cholinesterase.

Interaction With Receptor

At a given concentration of the drug at a receptor site, the response achieved is a reflection of the number of unoccupied receptors, the prevailing internal environmental conditions, and the integrity of the responsive structures.

With age, there is a decrease in the number of viable and active cells within a number of different tissues and organs. With regard to this decrease in the central nervous system, it has been suggested that the action of stimulants is decreased while the activity of depressants is enhanced. There are data, particularly in the experimental animal, to support this hypothesis. The best example is afforded by studies examining the activity of amphetamine. The ability of this compound to increase spontaneous motor activity is markedly decreased in old rats; its ability to depress food intake, however, is enhanced. Other stimulant drugs (strychnine) have been reported to be less effective in older experimental animals, while depressants (barbiturates) exert a greater effect.

When the number of active cells is decreased, the pharmacological action of the drug may be greater merely on the basis that the dose per milligram of active tissue is increased. This reasoning has been used to explain the more pronounced diabetogenic effect of alloxan in older animals. This drug produces a greater elevation in blood glucose in an old animal which possesses fewer pancreatic beta cells.

Changes in the structural components of a responsive tissue may also modify the action of a drug, regardless of the integrity of the receptor site. It has been reported that aortic smooth muscle of old rats is less responsive to nonrepinephrine when the effect is compared to response seen in younger animals. This change was found to correlate with a number of structural changes including the initial stages of atherosclerosis. It was concluded that the structural changes were of sufficient magnitude to result in a mechanical limitation of the response that could be achieved by the neurohumoral agent.

Homeostasis

The primary response to a drug often elicits a number of secondary responses which are mobilized in an effort to stabilize internal environmental conditions. When the ability to adjust to these changes is impaired, there may be a greater secondary effect and lessened tolerance to the primary effect of the drug. It is well known that elderly patients exhibit a deficiency in the ability to meet these demands, including restricted powers of adjustment to both high and low temperatures, limited regulatory mechanisms for maintaining blood sugar levels, decreased ability to restore acid-base equilibrium, and decreased response to orthostatic stress (decreased sensitivity of the carotid sinus mechanism).

These losses are reflected for the most part in a decreased tolerance of elderly patients to drugs. An excess of nitroglycerin in an older individual may lead to syncope; for this reason the initial dose should be

smaller than one would employ in a younger and more resilient patient. Other drugs which reduce blood pressure are more apt to cause hypotension and circulatory insufficiency in elderly patients. This is particularly true for compounds exerting an effect on the central nervous system, such as the phenothiazines, antidepressant compounds, and general anesthetics. Surgical patients receiving general anesthesia may exhibit a fall in body temperature, and it has been reported that this fall is more pronounced in patients in older age groups. The demand for oxygen that occurs during this time of reduced body temperature could in some instances be particularly hazardous.

MODIFICATION OF DRUG ACTIVITY IN THE ELDERLY PATIENT

The observations noted above clearly suggest that age influences a number of mechanisms which are important determinants of drug action. While they have some practical significance to the physician in his daily practice, it is difficult to apply these observations on the basis of age *per se*, for all patients do not age at the same rate, and indeed various tissues within a given individual do not show the same decline in function with age. Therefore, judgments are best made using the biological age of the individual rather than his chronological age, or, in other words, the use of drugs in elderly patients must be individualized, based on the knowledge of the biology of the individual.

Data reported in the literature comparing drug efficacy and safety in patients of different ages are limited. Furthermore, studies conducted in patients of different ages cannot be considered, for the most part, experimentally adequate. This is not necessarily the fault of the investigator, for age was not initially intended to be a major parameter in the study. For these reasons caution should be exercised in extrapolating these comparative observations and judging the relative merits of a particular drug on the basis of these data alone. The observations cited here are only suggestive; no attempt has been made to review the problems in depth. More complete information may be found in the review articles listed at the end of this chapter.

Psychotherapeutic Agents

A number of psychotherapeutic agents are extremely useful in the treatment of a number of mental disorders of the aged. Regardless of age of the patient, the phenothiazines produce depression of the central nervous system characterized by decreased anxiety, tension, and excitement. Experience suggests that there are no age-related differences in the mechanisms relating to absorption, distribution and metabolism in geriatric patients, and the therapeutic response to these drugs appears to be unrelated to the age of the patient.

Though none of the drugs in this therapeutic class are contraindicated on the basis of chronological age alone, they must be used with caution in the elderly individual because of side effects. Hypotension produced by the phenothiazines occurs more frequently in the older and more atherosclerotic patient. If this is a problem, the dose may be decreased by about half. After a week or two, this effect will subside and, if necessary, the drug dosage may be increased.

The incidence of extrapyramidal reactions also appears to increase in elderly patients. Because of the potential hazard of alterations in liver function produced by the phenothiazines, they must be used cautiously in older patients. Reserpine, though useful, is more likely to produce depression in the elderly. The milder tranquilizing agents, such as meprobamate and chlordiazepoxide, are useful in elderly patients and may be used safely.

Antidepressants

Reports in the literature suggest that the effectiveness of some of the antidepressants may be modified by the age of the patient. In patients with endogenous depression, imipramine appears to be less effective in elderly patients, while the response obtained with the use of amitryptyline is the same for patients of all ages. In depressive reactions, no age differences are apparent with either drug. In the case of monoamine oxidase inhibitors, there may be a decrease in the therapeutic efficacy in elderly patients.

The physician should be alert to the fact that the monoamine oxidase inhibitors are capable of potentiating the action of a number of drugs. For this reason, they should be administered with caution in patients receiving other drugs. Drugs in this therapeutic class may induce hypotension in some patients, and the results of some studies seem to indicate that this response occurs more frequently in older individuals.

Hypnotics and Sedatives

Hypnotics and sedatives are frequently employed in the aged in the treatment of anxiety, tension, insomnia

and nocturnal restlessness. They may also be employed as daytime sedatives. These compounds are used because they produce a nonselective relief of anxiety and are capable of inducing sleep without the characteristic effects of the more potent tranquilizing agents.

It has been repeatedly observed that older individuals have increased sensitivity to the effects of barbiturates, showing such reactions as delirium, disorientation, forgetfulness and apprehension. The altered sensitivity to the barbiturates has been attributed to (1) impaired renal function resulting in drug accumulation, (2) reduced drug metabolism; and (3) variation in the effect of age on different centers of the central nervous system. Because of the potential intolerance, it is necessary to individualize the dose and selection of the barbiturate to be employed. Indeed, the physician may also wish to modify his choice of medication. Glutethimide is perhaps the most useful of the nonbarbiturate sedatives. It produces a reliable hypnotic effect and may be considered as a barbiturate replacement in the treatment of insomnia in a barbiturate-intolerant patient.

The elderly also have increased sensitivity to the action of bromides, and again this has been attributed to delayed elimination of the drug by the kidney. Chloral hydrate is reported to be an extremely useful sedative in the elderly with a minimum of side effects.

General Anesthetics

Despite the number of problems that are presented by the aging patient, successful anesthesia can be achieved if the drugs are properly administered and prolonged administration is avoided. The disadvantages of various agents include the risk of circulatory collapse with ether, the possibility of cardiac irregularities and depressed respiration with cyclopropane, and the anoxia that can be induced by nitrous oxide. Thiopental is usually contraindicated in the severely ill and senile patient.

Narcotic Analgetics

The potent narcotic analgetics must be used with extreme caution in the elderly patient. Some have suggested that the aged are more sensitive to the depressant action of morphine, and as a result the dose should be reduced to about one-half the dose employed in young adults. In patients over 70 years of age, it has been suggested that morphine not be used. The undesirable actions of morphine, which are potentially more serious in elderly patients, include respiratory depression, gastrointestinal effects and genitourinary difficulties. If a decision is made to employ morphine, the dose should be adjusted to meet the requirements of the individual.

Meperidine is a valuable analgetic with a low order of toxicity. Undesirable effects, particularly in the elderly, include nausea, dizziness, and hypotension. Methadone is also a synthetic narcotic and appears to be the drug of choice in the aged because of its effective analgetic properties, reduced degree of sedation, and absence of respiratory depression.

Anti-Inflammatory Agents

Rheumatoid arthritis, osteoarthritis and other musculoskeletal abnormalities are frequently encountered in older individuals. The crippling symptoms of these disorders demand prompt attempts at effective relief. The salicylates are perhaps the drug of choice in older patients, while the steroids and more potent nonsteroidal compounds should be reserved for cases where inflammation is extremely painful and severe. The response of the elderly to anti-inflammatory therapy is approximately the same as one might anticipate in younger individuals. Nevertheless, the secondary responses to these agents indicate a need for caution when they are employed in geriatric patients.

In general, the salicylates may be used safely and effectively in an elderly individual. When there is depressed renal function, however, there is the possibility of CNS disturbances signaled by deafness, tinnitus, vertigo, and confusion. Other disturbing effects include gastrointestinal bleeding and decrease in prothrombin time.

The steroids cause a number of side effects which are of particular concern when these agents are employed in older individuals. These include electrolyte disturbances, fluid retention, osteoporosis and reactivation or initiation of peptic ulcer. Effects on protein catabolism and calcium loss may occur. When the steroids are employed, it may be necessary to restrict dietary intake of salt to avoid the tendency toward fluid accumulation. While very gratifying therapeutic results may be achieved with the steroids, continued treatment is not recommended.

Symptomatic relief may also be provided by the more potent nonsteroidal agents such as phenylbutazone and indomethacin. The dramatic improvement which may result from the use of these agents is attenuated by a greater frequency of undesirable effects in the aged. The serious toxic reactions to phenylbuta-

zone, including digestive disturbances, activation of peptic ulcer and agranulocytosis, increase in frequency with age. As with the steroids, the physician must also be alert to sodium and water retention which may occur with this drug. Phenylbutazone is not a drug to be used casually, and it should not be employed for long periods of time.

Indomethacin is used in the treatment of rheumatoid arthritis and osteoarthritis. There is a suggestion that this drug should be used with caution in old people. Side effects encountered with this agent include headache, diarrhea, nausea, activation of a peptic ulcer, and abdominal pain.

Antihypertensive Agents

An elevation in systemic arterial blood pressure in elderly individuals is not necessarily an indication for antihypertensive therapy. If a decision is made to treat an elderly patient for high blood pressure, vigorous therapy certainly is not suggested. An established high blood pressure level associated with atherosclerosis demands a cautious approach to therapy, since a rapid and drastic reduction in pressure can result in cerebral and coronary insufficiency.

The thiazide diuretics are the drugs of choice in the elderly hypertensive. Since some older patients take a diet deficient in potassium and some elderly individuals have a decrease in body potassium stores, there is a tendency toward an increased incidence of hypokalemia with the use of the thiazides in older patients. Thiazides tend to increase blood sugar levels in susceptible individuals, and in the older patient the physician must be particularly alert to this effect, since with increasing age there is a tendency toward pancreatic insufficiency and late maturity-onset diabetes.

Small doses of reserpine can be effective, particularly in combination with the thiazide diuretic. The fact that reserpine produces depression, however, limits its utility, particularly in patients over 70 years of age.

Only in a few selected individuals should the more potent compounds, such as alpha-methyldopa, ganglionic blocking agents, or guanethidine be employed. These agents are reserved primarily for patients with high blood pressure who fail to respond to milder therapy, and in whom a reduction in blood pressure will bring about a regression in some of the secondary manifestations and symptoms of hypertension. It has been suggested that the ganglionic blocking drugs are less effective in the elderly and are more apt to cause side effects, including urinary retention and dizziness. Methyldopa is effective in elderly patients as is guanethidine.

Diuretics

A number of diuretics are available which afford effective treatment of edema associated with cardiovascular, liver, and renal disease. The results of most studies conducted in elderly patients indicate little change in the therapeutic efficacy of these agents. Recently, however, it has been suggested that furosemide and ethacrynic acid do not increase the excretion of water and electrolytes in elderly patients to the extent that they do in younger individuals.

The possibility of the side effects of diuretics increases in elderly individuals, particularly those which relate to an effect on kidney function. Variations in serum potassium appear to occur more frequently in the aged. The thiazide diuretics, furosemide, and ethacrynic acid produce an increase in urinary potassium excretion, and there is a greater tendency for these agents to induce hypokalemia in the elderly patient. This is of particular concern, since many of these individuals are being treated for congestive heart failure and are concomitantly receiving a digitalis preparation.

Triamterene is an agent which reduces potassium excretion and offsets the loss of potassium induced by the thiazides. Because it decreases the excretion of potassium, triamterene may occasionally produce hyperkalemia. This response, where it occurs, is seen more frequently in elderly patients.

All potent diuretics cause an increase in blood urea nitrogen levels and, as might be expected, this effect is seen more often in older patients.

Antianginal Agents

The drugs of choice in the treatment of myocardial insufficiency and angina include nitroglycerin and the long-acting organic nitrates. These compounds appear to be effective by reducing left ventricular work rather than by preferentially and selectively increasing coronary flow. Since the aged are less capable of responding to postural stress, these agents are more likely to induce tachycardia, hypotension and synscope. Should such an effect be observed, the dose should be reduced.

Antiarrhythmic Agents

Procainamide and quinidine are frequently employed in various conditions associated with irregular rhythm. Procainamide may produce a sudden fall in

blood pressure and thus the compound should be administered with caution in the elderly. In patients of this age group, the tolerated dose of both quinidine and procainamide is less than in younger patients.

Digitalis

The primary pharmacological action of digitalis and the cardiac glycosides is essentially the same in patients of all ages. Nevertheless, there are differences in the clinical response of the aged that should be noted. The elderly patient is less resilient and adaptive, and thus the range of effective therapeutic action is limited, and the chance of untoward and toxic reactions from therapeutic doses, including anorexia, hazy vision, cardiac arrhythmias, and allergic responses, is increased compared to that of the average younger patient.

Anticoagulants

Opinion is divided on the merits of anticoagulant therapy generally, and more specifically on the use of these agents in the elderly patient. It is not the purpose of this discussion to enter into this controversy. Suffice it to say that the indications for use of the anticoagulants are the same in the elderly patient as in younger adults; in the aged, however, anticoagulants may be a source of special danger, and for this reason they are used with less enthusiasm and are considered by some to be contraindicated in patients over seventy years of age. The concern is that old and atherosclerotic patients are more likely to respond with a lowered prothrombin time. Since bishydroxycoumarin is detoxified in the liver and excreted by the kidney, impaired hepatic and renal function may be responsible for the enhanced drug effect.

Drugs Acting on the Autonomic Nervous System

Many compounds which exert an effect, either as stimulants or as blocking agents, on the autonomic nervous system are employed in the therapy of a number of disease states.

Some of the sympathomimetic amines and their analogs are used as appetite suppressants. In elderly individuals, this effect is apparently enhanced, while the stimulant effect is decreased and apparently better tolerated by elderly than by young patients.

The parasympathomimetic agent, methacholine, is employed in the treatment of paroxysmal tachycardia. In patients over 50 years of age, the dose must be adjusted upward by a factor of 2 to 3 times the usual dose employed in a young adult.

With advancing age, there is an increase in the incidence of glaucoma and in the number of patients who require treatment. Methacholine is an effective drug for this condition. Another parasympathomimetic agent, bethanecol, is useful in the treatment of urinary retention and gastric atony and retention. However, the physician must be alert to the hypotensive effect of these drugs and to their effect on bronchiolar function.

Parasympatholytic agents, such as atropine, must be used with caution in elderly patients because of the increased frequency of borderline glaucoma. Reduced internal secretion produced by these agents may also cause problems in elderly patients, as can blurring of vision which often results. There are some striking differences in the response of elderly and young patients to the cholinergic blocking agents. In the elderly there is a decrease in the effect of atropine on the heart and an increase in the effect on the eye and bladder.

Antihistamines

The physician should be aware when using antihistamines that they are more likely to cause dizziness, sedation and hypotension in elderly patients than they do in younger patients.

Anti-Infectious Agents

The primary action of anti-infectious agents is, of course, directed against the invading organism. Thus the general principles governing the use of these compounds are the same regardless of the age of the patient. Nevertheless they should be used with caution in the older patient because of the presence of depressed renal function with the tendency toward drug accumulation. The administration of a standard intramuscular dose of these agents produces higher blood levels in older than in younger individuals.

PRACTICAL CLINICAL CONSIDERATIONS AND CONCLUSIONS

Some general concepts and principles that should be kept in mind in treating geriatric patients are listed below:

1. Indications of drug usage are not generally related to the age of the patient. Though some diseases are more prevalent in patients in older age groups, the symptoms requiring relief are not, for the most part, different from those encountered in younger patients.
2. Though age can modify the actions of drugs and

the factors responsible for the way in which the body handles them, the magnitude of these changes does not serve to limit the utility of most drugs in the elderly. In many cases, however, a reduction in dose may be desirable.

3. With few exceptions, drugs are effective and safe in elderly patients and few, if any, are contraindicated. Where there are special or known hazards in drug activity to the older patient, however, the physician should consider the use of an alternate medication. For example, a synthetic narcotic may be substituted for morphine, and glutethimide may be substituted for a barbiturate.

4. Drug treatment in the elderly should be based on (a) an accurate diagnosis, (b) familiarity with the characteristics of the drugs available; (c) a thorough knowledge of the biology of the patient; (d) known age differences in drug activity; and (e) appreciation of those factors which influence the duration and magnitude of drug response. The aging process is not consistent from patient to patient, and thus chronologic age alone is not an adequate criterion for judging the needs and the state of an older individual. It is necessary to prescribe drugs with a thorough knowledge of the patient's biologic age as it is related to the factors which influence absorption, excretion and metabolism of the drug.

5. Elderly patients exhibit multiple pathology and in many cases receive simultaneously a number of different drugs, with varying potencies, and varying pharmacologic properties. Thus, it is necessary that drug incompatibility be fully understood before any drugs are used in combination. For example, the use of a monoamine oxidase inhibitor may potentiate the action of a number of drugs; a thiazide diuretic may cause loss of potassium and thus precipitate digitalis toxicity; the concomitant administration of aspirin with an anticoagulant may result in a dangerous prolongation of prothrombin time.

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SECTION C/ASPECTS SPECIAL TO THE ALLIED HEALTH PROFESSIONS

Part XV/Clinical Psychology

PSYCHOLOGICAL STUDY IN THE MANAGEMENT OF THE GERIATRIC PATIENT

By

Samuel Granick, Ph.D.

INTRODUCTION

Medical and personal-social problems are among the most important and frequently encountered experiences of the aging individual. These problems are so interrelated that the geriatric practitioner must orient himself toward a psychosocial study of his patients as part and parcel of the medical examination. Planning and administration of treatment are also to be considered in the light of its psychological effects, as well as in relation to the patient's psychological readiness and ability to manage and cooperate with the treatment. Generally, therefore, it seems quite important that the physician gain an intimate awareness of the psychological aspects of aging as they interact with medical problems, and become acquainted with procedures for systematically assembling and using various categories of psychological information.

Many aged patients in a physician's practice are well understood by him since he has been their doctor and confidant for several years. His awareness of their personality and intellectual characteristics, as well as the nature of their social and family experiences, normally enables him to view their medical problems in broad perspective, and to adapt his treatment and guidance accordingly. He is in a position to recognize in his patients the developing impairments of their intellectual, adaptive and visual-motor skills associated with the aging process, and various medical conditions, particularly those involving cardiac and circulatory functioning. Moreover, compensations for such losses of skill which they are able to make, through the use of stored knowledge and the exercise of judgment developed through long experience, are familiar to him and given consideration. In addition, he understands the limits of such compensations and is not unrealistic in his expectations about the patient's management of his therapy and regulation of his behavior and activities.

The aged patient who is new to the physician, however, calls for other considerations, particularly if his medical status is complicated by severe and multiple impairments. Similarly, the patient who is well known to the physician, but who is experiencing radical changes in his physical condition, must be studied more extensively than through standard medical procedures. The individual's psychological status requires close attention, both from the standpoint of its effect on the physical illness and the ways in which the illness conditions his psychological reactions and behavior. Often it may be difficult to determine whether the physical is secondary to the psychological or vice versa, or whether they are of equal diagnostic significance.

A problem in differential diagnosis may arise when apparent CNS symptoms are accompanied by disturbed emotional or social or intellectual reactions, all leading to much uncertainty as to whether the primary factor is organic or psychological in nature. Such kinds of diagnostic difficulties are encountered in fairly common situations, as when a patient starts to complain about diverse symptoms and at the same time has recently lost his or her spouse, or has been forced into retirement from a regular occupation, or has been left behind by children who have moved to new locations. Associated with these symptoms may be marked depression and even expressed ruminations about suicide.

The need for objective information about the patient's psychological makeup, history and current functioning is quite apparent when the physician is confronted by these kinds of problems. Significant help in many areas can be gained by utilizing the special skills and critical judgment of the clinical psychologist. Employing psychological testing, interviews and observations of the patient's behavior, the psychologist is able to provide information and clinical impressions which can facilitate differential diagnosis and help in the formulation of a realistic treatment program. A psychological study can also help the physician to direct the patient toward suitable consultation and therapeutic and rehabilitation resources.

The use of the psychological study as an integral part of the total medical examination and management of the geriatric patient is a fairly new orientation and procedure for the average physician. Therefore it seems desirable to consider the factors which support such an approach, along with the specific and practical ways in which it can be handled.

A review of the following areas will be presented in this chapter: (a) the most significant psychological aspects of aging as they are related to the individual's physical status; (b) methodology for studying the geriatric patient's psychological makeup and functioning; and (c) use of the psychological information by the physician in the medical management of his aging patients.

PSYCHOLOGICAL ASPECTS OF AGING AND THEIR RELATION TO PHYSICAL STATUS

Physical Effects From Psychological Illness

As individuals move through the middle years into the seventh and eighth decades of life, awareness of "growing old" comes through quite decisively. Reduction of energy level and physical strength, changes in the skin and hair color, along with other obvious signs of aging, exert important psychological effects on the individual. Problems of adaptation to new life circumstances are faced, and these are likely to generate abundant anxieties and tensions. Men particularly are faced with the task of finding new directions for satisfaction and meaningful use of time as they retire from their regular jobs at age 65 or somewhat later. Both women and men are forced to note that their family situation and roles have changed since their children are now grown and independent. Within the community itself, the aging person can readily detect that as part of the passing generation he is no longer viewed with the deference and attention he commanded during his active and productive years. This society tends to look ahead rather than into the past, and is far more child and youth oriented than interested in the potentials and needs of the aged. Thus the aged person is confronted with a situation which can stimulate a sense of loneliness, social isolation, rejection and uselessness.

Meeting this challenge and adapting constructively to these new circumstances is a difficult problem, but yet one which is definitely possible to resolve effectively. It is a problem which the physician very often sees in his office as he listens to his elderly patients recite what is bothering them. It is one about which he can help his patient to a significant extent, if, along with his medical knowledge, he also has a clear comprehension of psychosocial aspects of aging, the means for defining the patient's psychological makeup and needs, and the information about community welfare, social, recreational and vocational services and resources.

The psychosocial problems of the aging individual and his physical problems tend to be closely interrelated. Each affects the other very significantly, so that often it may be difficult to specify which is most important. The frustrations and anxieties associated with new adaptations faced by the aged individual are a considerable source of nervous tension. Depressed feelings are common along with a tendency toward hypochondriacal complaints. Even more significant from a medical standpoint are the added pressures which anxiety and tension place on the physical systems, exacerbating actual disturbances which already exist. Thus, the emotional and physical pressures faced by the aged individual make him a good target for psychosomatic ailments, originating particularly from the gastrointestinal, cardiovascular and pulmonary systems. Essentially it should be recognized that the old person is characterized by markedly weakened defenses against both physical and psychological ailments, and that a combination of these factors must be understood and dealt with by the medical practitioner in order to make his therapeutic work effective.

Psychological Effects From Physical Illness

Physical regression and consequent loss of functional effectiveness are among the most obvious aspects of growing old. For many of this group, various dis-

eases take a significant toll on their strength and energy. Painful discomforts markedly reduce speed of reaction, defective sensory functions, weakness, digestive tract symptoms and a variety of somatic ailments play a considerable role in the old person's consciousness. Moreover, there is a keen awareness of the relative closeness of death. These factors stimulate important psychological reactions in the individual and consequently affect significantly his physical status and ways of living.

Increased physical regression leads to fear of illness and increases tendencies toward hypochondriasis. Nervous tension also is associated with concern for one's physical health, which then tends to exert a generally destructive effect on morale and outlook toward life. It is at such times that the geriatric patient may become very dependent on the family physician for reassurance, support, and the development of a balanced perspective about his physical status and ways of maintaining his health.

A clear understanding of the patient's psychological make-up and personality characteristics is thus important for the physician in his counseling and management of the patient. It becomes a particularly crucial matter when the patient has been going through, or has been recovering from a severe illness. Awareness of the patient's emotional patterns, characteristic ways of coping with life problems, level of maturity, personality strengths and weaknesses may then be very useful to the physician in assisting the patient toward constructive adaptations to his circumstances. The physician may then be able to help the aged person avoid the severe psychologically debilitating depressions to which he is so prone as a reaction to physical problems. Moreover, he may be able to anticipate suicidal inclinations (a very prevalent pattern in the aged) and provide or arrange for safeguards and treatments.

Illness in aged people has a far-reaching effect psychologically, not only on the patient but also on his family members. The patient can usually do far less for himself in obtaining needed services and in managing himself both during illness and convalescence than during former years. Moreover, illness and resulting weakness may last for longer periods of time. Thus the patient becomes increasingly dependent on his family, often making extensive and persistent demands for attention and services.

Illness is likely also to stimulate very considerable personality regression in the elderly, leading to marked emotional immaturity and self-centeredness. As attention then becomes focused on the patient by doctors, nurses, family and friends he may gain a newfound sense of personal value and importance. This is likely to be the case, particularly, if the elderly patient has, prior to the illness, experienced a sense of social isolation, neglect, uselessness and loneliness. His present illness may thus provide a significant "secondary gain" of attention, affection, concern of others and emotional support. At first this is likely to give a valuable boost to his morale and spirits. As he improves in health, however, and some of the attention and concern are withdrawn, anxiety about a return of the previous social isolation and sense of uselessness is likely to be generated and followed by increased complaining, hypochondriasis, self-centered demandingness and depression. The aggravation, guilt, anger and nervous tension which this stimulates in those associated with the patient and the dislocation it causes in interpersonal relations are familiar to all physicians.

The family members of the elderly patient are usually caught up in very disturbing conflicts and problems as they attempt to make provisions for and to adapt to his needs. Too often these needs are quite varied and extensive and extremely difficult to meet in terms of time and energy. Since the family members, moreover, generally have their own families and affairs to care for, the strain can become increasingly severe. In addition, extended life expectancy is increasingly creating situations in which the children of elderly parents are being confronted with their own personal problems of being aged and in need of special attention.

The treating physician, in his concern for the speedy recovery of his patient, is in the difficult position of trying to reduce the patient's anxiety and disturbing tensions by helping him maintain a reasonable orientation toward members of his family. In turn, much guidance and counseling are needed by family members in their dealings with the patient, and it is quite natural for them to turn to the physician for help along these lines.

Treating the geriatric patient, therefore, becomes a complicated problem of combining medical services with psychosocial guidance for both the patient and family members. Therefore it is important that the doctor have a good understanding of the family makeup and its psychological characteristics. The patient's personality patterns, mental strengths and weaknesses, and the psychological dynamics of his relationship to the family are significant aspects of this understand-

ing. With such information in hand, the physician may provide considerable help to all concerned in achieving a balanced relationship. Planning for post-illness care and for the arrangement of living circumstances for the patient along realistic lines can then proceed cooperatively in an intelligent and mutually beneficial fashion.

METHODOLOGIES FOR PSYCHOLOGICAL STUDY

Psychological and Social Survey Within the Medical Assessment

It has long been a part of medical assessment to include data on the patient's psychological, social and environmental history and present status. Implied in the foregoing discussion is the contention that the geriatric patient is particularly vulnerable to psychosocial circumstances, and that attention to these matters is a very important aspect of his medical treatment. The systematic collection of data on the individual's past and present personal-social adjustments and behavior patterns should, therefore, be incorporated in the evaluative procedures followed by the physician. Judgment is, of course, to be exercised regarding the intensiveness and extensiveness of the study in relation to the complexity and requirements of the case at hand. However, awareness should be maintained of some basic guidelines which are to be followed in each instance.

Several basic questions confront the physician in dealing with the psychosocial aspects of his patient's situation. To plan intelligently with and for the patient, information should be assembled along the following dimensions:

1. What are the psychological and social assets of the patient that can help him to cope with his illness and the aging process?

2. What are his essential personality characteristics and behavior patterns? How does he handle his problem experiences? Is his present behavior or reaction to illness a situational response to circumstances or a reflection of long-standing patterns of functioning?

3. What is the patient's status and relationship with the members of his family? To what extent is the family able and willing to help and cooperate with him? To what extent is he willing and able to cooperate with the family?

4. What are the community resources which may be useful in helping the patient with recovery and convalescence, and with resolving his personal-social adjustment problems? How can he be enabled to use these resources?

Often these questions may be adequately answered and the information used effectively through the physician's routine history-taking and observations. In many instances, however, the situation is likely to be very complex and requires the consultative services of other professional workers such as a social worker and/or a clinical psychologist and/or a psychiatrist. It would be quite profitable for the physician to be well acquainted with the nature of the diagnostic and therapeutic services which these three professional workers are trained to provide, so as to be able to work cooperatively with them on suitable occasions.

In the discussion below, attention will be given primarily to the characteristics of study by a clinical psychologist. The data and results of such an examination should provide a basis for judgments with regard to questions 1 and 2 above.

Questions 3 and 4, however, call for social service study and evaluation.

For relatively uncomplicated types of cases, the essential background information can be assembled by the physician himself, his nurse, or his secretary, through the completion of suitable history forms directed to the patient and close family members.

The Cornell Medical Index can also prove helpful, since it is a well-standardized questionnaire and provides a general survey of the symptomatology and medical history as perceived by the patient himself. Norms are available for both sexes so that he or she can be compared with the general adult population for extent and kinds of medical conditions experienced. The questionnaire can be administered by the physician's nurse or other trained assistant prior to the actual medical examination. It may then serve as a means of determining how realistically the patient perceives his physical and mental status. Of particular significance are the indications which can be derived from this questionnaire as to the patient's possible needs for further psychological and psychiatric study and attention.

Additional information which should be obtained includes data on the educational, marital, vocational, recreational and family background of the patient. In this regard, it would be advisable for the individual physician to develop a form or schedule of questions and checklists of details to facilitate the gathering of

the data. The following categories of information should be included as a minimum.

1. Place of birth and cultural environment in which development years were spent.

2. Education and vocational training.

3. Vocational background and socioeconomic status.

4. Marital history, family relations, children's education, vocations and present marital and family status.

5. Past and present interests, hobbies and activities.

6. Social contacts with family and friends in past and present.

7. Attitudes toward aging and outlook for the future.

8. Specific information on ability to dress, bathe, generally care for self, handle finances, and use public transportation.

As the physician becomes well acquainted with the social and personal problems of his patients, he will recognize that they often require a variety of social and welfare services. For example, social isolation is a frequently encountered problem with aged individuals and very often problems in family relations require attention. Financial and living arrangement difficulties are also among the most common situations facing the aged individual.

Help with such problems can generally be obtained within the community, but one must know where to apply and have the energy and initiative to make the contacts. The physician can be very helpful in these matters by making the referrals to the appropriate service agencies. In the hospital situation, the matter can readily be handled by the social service department, but for private office patients, the physician is expected to provide the needed information and help. Most communities publish a directory of social and welfare agencies, which he should have available. When it is difficult for the patient or the family to make the contact, the physician himself or his nurse, calling in his name, can facilitate the matter. Often the elderly patient requires somewhat more than the usual amount of encouragement and help in getting to needed services. The persuasive manner of the physician, plus his active efforts in making the initial contacts, can go a long way toward giving both the patient and his family the courage to help themselves.

The Psychological Examination

The primary value of psychological testing is the assembly of data about the patient's behavior, attitudes and emotional reactions which can be objectively assessed in terms of norms or standards for his age group. Related to this is the opportunity to compare his response patterns with those of other groups, and thus gain some perspective about his relative effectiveness in dealing with various kinds of tasks and problems. For the aged patient, this is particularly important, since it facilitates the evaluation of the extent and quality of his residual capacities for adapting to his changing life circumstances. Moreover, it provides a basis for gauging the degree of the inroads the aging process and illness have made on his mental and personality resources. Some leads may also be derived from the test results as to his recuperative capacities or resiliency in responding to stimulation for recovering or even improving his functioning.

Psychological testing and interpretation of results is a specialty area in the field of psychology referred to as clinical psychology. The testing is carried through by the clinical psychologist or by a trained worker under his supervision. The patient is interviewed with respect to his activities, interests, reactions to various circumstances of his present and past life, attitudes and feelings toward himself and his environment. His behavior is also observed carefully as he works on several tests and talks of himself and others. Scaled evaluations are then made of his reaction patterns, such as ability to maintain attention, ease of shifting from situation to situation, anxiety and tension levels in response to frustrations, quality of self-expression, and appropriateness of responses. Insofar as possible, the specific responses of the patient in his own words are recorded on the various tests to enable the psychologist to study and evaluate them both quantitatively and qualitatively.

Interpretation of the test results is a complex process, despite the relative objectivity of the testing situation and the availability of norms. Evaluation of the qualitative aspects of the patient's performance must be made and related to the levels of performance achieved. Moreover, since a battery of tests is involved, the inter-test similarities and variabilities are given consideration. Thus, the diagnostic description which evolves from the analysis represents the integration of a host of intellectual, psychomotor and personality factors which are dynamically active within the patient and which are to be viewed in terms of his individuality and his current physical and sociopersonal status. Normally, conclusions flow from this analysis which can be expected to be useful in develop-

ing and carrying through a rehabilitation program with the patient.

A very large array of psychological tests is available to the clinical psychologist for use in studying patients. The choice of a specific battery of tests in a given case must be related essentially to the aims and purposes of the examination. The referring physician should, therefore, try to ask specific questions and opinions of the psychologist. At times, however, it may be difficult to be specific, and consequently a general evaluation is requested. The psychologist then handles this by reviewing the patient's medical chart and discussing his current sociopersonal situation with him to develop some concept of the problems of adjustment the individual may be facing. During the course of the testing itself, a number of other problems might become apparent which need exploration.

Generally, there are several broad areas of psychological functioning which serve as guidelines to the psychologist in the selection and organization of his testing battery. The following outline of the areas constituting psychological evaluation may serve as a guide for the physician in formulating his own aims and purposes for requesting the examination in individual cases.

1. *Adaptation to the Testing Experience*

a. Initial adjustment and maintenance of adjustment through the testing session(s) (generally 2 to 4 hours).

b. Ability to maintain effort and attention to tasks at hand, particularly when materials or problems prove difficult or frustrating.

c. Ability to express self; quality of speech and language usage.

d. Quality of relationship to examiner; manifestations of sociability, sense of humor, dependency versus independence, passivity versus aggressiveness.

e. Quality of emotional reactivity; maintenance of tension and anxiety, evidence of emotional control, appropriateness of emotional reactions during testing.

2. *Intellectual Makeup and Functioning*

a. Capacity or general endowment in comparison with present level of functioning.

b. Areas of intellectual strength and weakness; areas of particular weakness or loss of functioning at present compared to the past.

c. Quality of mental functioning and ways of dealing with intellectual problems: systematic versus disorganized approach; abstract versus concrete handling of experience; ability to exercise imagination or creative thinking; flexibility versus rigidity of performance.

d. Extent to which emotional factors or problems may be inhibiting or blocking mental functioning.

e. Evidence of disorganized or autistic thinking; contact with reality and orientation to time and place.

f. Educational or cultural level in relation to intellectual abilities; level of present skills in basic academic areas of reading, spelling and arithmetic in relation to formal education.

3. *Psychomotor and Perceptual Functioning*

a. Ability to coordinate visual and motor stimulation.

b. Grasp of spatial relationships.

c. Perception of figure and ground relationships.

d. Adaptation to old and to new symbols.

e. Performance under pressure of speed of reaction and movement.

4. *Personality Makeup and Functioning; Social Adjustment*

a. Emotional balance and control; ability to direct behavior along realistic lines.

b. Characteristic patterns of behavior in dealing with emotionally stimulating experiences.

c. Orientation toward other people and quality of social adjustments; responsiveness to other people's feelings.

d. Ability to deal with anxiety, tensions and crisis experiences in controlled fashion.

e. Self-concept and perception of his position and functioning in his environment.

f. Ambitions and general orientation toward the future.

g. Level of social and emotional maturity for his age.

h. Evidence of psychopathology, if present; its characteristics, intensity and effects on his daily life adjustments.

i. Extent to which the individual is aware of himself and his problems and his motivation for dealing with them. Unconscious factors, if any, which may be affecting the individual adversely.

j. Acute and chronic problems which the individual may be facing.

Specific techniques are followed by the clinical psychologist in assembling information and behavior samples from the patient on each of the 4 descriptive areas noted above. The examination procedure is standardized to provide a laboratory-like setting in which the

patient's functioning may be observed and various aspects of his behavior recorded. Each of the tests has a set of directions which is followed by all who administer and take the test. Scoring of the results is also done in a standard fashion. The training and clinical experience of the clinical psychologist come into play, however, in the evaluation of the qualitative features of the patient's reactions and in the integration of the total examination results.

For Section 1, *Adaptation to the Testing Experience*, the examiner records his observations and impressions of the patient's behavior during the examination. Generally a set of rating scales is used which covers the various features noted in this section, so that the evaluations can be made in a complete and systematic fashion.

Many different kinds of tests can be used to elicit information for the other 3 sections. It would be worthwhile for the physician to have a general acquaintance with some of the more commonly used psychological instruments. Only those which are currently useful in the examination of geriatric patients will be described.

For Section 2, *Intellectual Makeup and Functioning*, the most widely used test is the Wechsler Adult Intelligence Scale (WAIS). It consists of 11 subtests, 6 eliciting verbal responses (Information, Comprehension, Arithmetic, Similarities, Vocabulary, and Memory for Digits Forward and Backward), and 5 nonverbal performances (Digit Symbol Substitution, Picture Completion, Block Design, Picture Arrangement, and Object Assembly). Directions are orally presented, and no reading is required of the patient. Norms are available for adults of various ages, ranging from 16 to above 75 years.

Another intelligence test which has been used extensively with elderly subjects is the Otis Self-Administering Test of Mental Abilities. It is a paper and pencil type of test on which the individual works by himself for 30 minutes. Reading skills and visual abilities of the patient must be adequate for the test to be useful. This test may also be administered on a group basis, which represents an efficient way of testing large numbers of subjects.

The Revised Beta Examination, derived from the Army Beta, a test developed for World War I army recruits, is an intelligence test which can be used with patients who are nonreaders. It, too, can be administered on an individual basis or in groups.

Another test of intellectual functioning which is nonverbal and involves no reading is called the Raven Progressive Matrices. It was developed in England but has had extensive use in this country and elsewhere since its content is relatively culture fair, that is, the content, consisting of designs, is cross-cultural. Capacities for observation and integrative thinking are measured by the test, and norms are available for the elderly, as well as for younger age groups.

Evaluation of the cultural or educational level of the patient can be estimated by the psychologist from the responses to the intelligence test, particularly from the Vocabulary, Information and Similarities sub-tests of the WAIS. However, to gain a fairly specific conception of the patient's basic educational skills, a variety of school subject achievement tests may be used which are graded from the elementary through the high schools levels. Often it is desirable to measure fundamental reading, writing and arithmetic skills. The reading section of the Wide Range Achievement is very useful in testing the word reading skills of the patient. Context reading, spelling, arithmetic fundamentals and problem solving, as well as other academic areas may be evaluated with the Stanford or the Metropolitan Achievement Tests, 2 popular and readily available psychometric instruments.

For Section 3, *Psychomotor and Perceptual Functioning*, overlaps both with the measurement of intelligence and the evaluation of personality makeup. Accordingly, the intelligence tests already described and the personality measures noted below may be used to cover this area. Often, however, specific tests are appropriate, particularly when central nervous system problems are involved and information is sought on effectiveness of motor and intellectual coordination. The Bender Motor-Gestalt Test is useful in this respect. It is quite simple to administer, consisting of a series of 9 geometrical patterns presented on individual cards to the patient to be copied. Various scoring systems and norms are available which facilitate interpretation of performance with respect to developmental level of visual motor functioning and perceptual effectiveness or ability to integrate elements of a unit. These factors help in differential diagnosis between disturbed or disorganized behavior, which is due to personality disorders, and that which is due to CNS dysfunctioning.

Another test along these lines is the Graham-Kendall Memory-for-Designs Test, consisting of 15 geometric figures which the patient is asked to reproduce from memory after a 5-second exposure. This test was developed specifically for detecting evidence of brain dam-

age (the kind which primarily affects visual-motor, perceptual, integrative and thinking functions) in patients. Published research studies indicate that it is one of the most valid for this purpose of the several tests available.

In cases calling for the evaluation of vocational rehabilitation potentials, psychomotor efficiency and perception of spatial relations may be important. The Stromberg Dexterity Test and the Crawford Small Parts Dexterity Test are examples of instruments which are useful for demonstrating an individual's gross and fine visual-motor coordination. Ability in the spatial relations area can be evaluated through a paper and pencil test such as the Minnesota Paper Form Board and a three-dimensional formboard such as the Minnesota Spatial Relations Test. There are also several kinds of mechanical abilities tests which may be helpful in estimating level of functioning along specific mechanical lines. The Bennett Hand-Tool Dexterity Test and the Bennett Mechanical Comprehension Tests are examples in this area. Norms are available for all of these tests which make possible comparisons of the patient with adults generally and with workers in various kinds of occupations.

Tests which generally apply to Section 4, *Personality Makeup and Functioning*, are of two varieties, objective and projective types. The former consists of questions or statements to which the patient responds with agreement or disagreement as to their applicability to him. In some instances the patient is required to estimate on a scale the degree to which a certain kind of behavior or feeling or personal characteristic is true about him. The patterns of responses by the individual patient may then be compared to the patterns displayed by groups of people with known psychopathologies and/or adjustment problems in various social and personal areas of functioning. Examination of responses to specific items of the test provides a more definitive indication of the kinds and extent of personality difficulties the person may be experiencing. Normal and functionally effective characteristics of the personality may also be described from the responses to the test items. Examples of this type of personality scale are the Minnesota Multiphasic Personality Inventory (MMPI), Cattell Personality Test, and the previously mentioned Cornell Medical Index. Mood and general morale are especially important features of adjustment in geriatric patients. Evaluation of these areas can be effectively achieved with the Clyde Mood Scale and the Life Satisfaction Scales. The latter is particularly valuable since it has been standardized for use with an aged population.

Projective type personality tests are designed to elicit spontaneous, personalized responses from patients to more or less vague or nonspecific stimuli. This provides data through which some understanding can be gained of the individual's fantasy life and the unique idiosyncratic aspects of his approach to problems of daily living. As with the objective type tests, comparisons are possible with response patterns of psychopathological groups of patients, thus providing a basis for differential diagnosis. Perhaps more significant, however, is the fact that the projective tests enable the patient to provide some of the content of his thoughts and feelings. Through this technique insight can be gained regarding his sensitivities, attitudes, direction of his energies and style of life.

Three kinds of projective tests are most commonly in use: (1)ambiguous stimuli without specific content, such as the Rorschach Inkblot Test; (2) stimuli which are generally suggestive but lacking in specificity of content, such as the Thematic Apperception Test (TAT), and (3) stimuli which tap specific areas of thought, behavior, attitude and feeling, but which can be used by the patient in a personal fashion, such as a Sentence Completion Test.

The Rorschach consists of 10 cards, each containing an inkblot, 5 being black and white, and 5 having additional colors, to which the patient associates whatever thoughts may occur to him. Factors of location of the associations on or within the inkblots, quality of the inkblots (such as form, color and shading) leading to the ideas or objects associated, and content of the associations are used by the clinical psychologist to analyze the individual's personality characteristics and patterns of functioning. This test is particularly valuable in providing information on the structural aspects of the personality and some of the significant unconscious features of the individual's reaction tendencies.

Content of the patient's thinking and feeling is derived from the Rorschach Test responses, but this is more fully obtained through the TAT and the Sentence Completion Test.

The former consists of a series of 20 pictures, 10 being presented at a single session, to each of which a story is associated. Encouragement is given the patient to use his imagination freely and to make the stories as exciting and dramatic as possible. Responses are recorded verbatim and then analyzed primarily for content, particularly with respect to the hero figure's

actions, thoughts and feelings. Attitudes are also analyzed toward parental, other authority, sibling, peer, dependent and other types of figures.

The Sentence Completion Test consists of a series of sentences which have been started and which the patient is asked to complete with the first thought which comes to mind. Spontaneity is encouraged to avoid defensive, nonrevealing responses. The sentences are concerned with specific relationships, attitudes, feelings and experiences, revealing such matters as the patient's self-concept, predominant feelings toward significant people in his life, and the position he perceives himself to have, in his environment.

PROBLEM AREAS SUITABLE FOR PSYCHOLOGICAL TESTING

In the actual practice situation, the geriatric physician would be inclined to call for a psychological evaluation when the patient's status raises one or more specific problems. The following are the typical problems for which consultation with a clinical psychologist would be useful. His approach to each problem would, of course, be along the general lines outlined and described previously. The specific procedures in relation to each problem, however, will be indicated herein.

Differential Diagnosis

1. *Distinguishing between mild and severe personality disturbances and defining the nature of the psychopathology involved.* Personality testing is most critical for this purpose. A projective test such as the Rorschach can provide a basis for gauging the extent to which the personality structure is intact, along with the relative severity of the emotional disturbance. The pattern and quality of inkblot associations, combined with data from a test such as the MMPI, can enable the psychologist to judge whether the patient is psychoneurotic or psychotic. A judgment can also be made as to the specific psychiatric classification of the disturbance shown by the patient.

2. *Defining the effects of brain injuries on mental, psychomotor and personality functioning.* Responses to psychological tests reflect the effectiveness of cerebral functioning in the areas of visual-motor coordination, problem solving, perceptual processes, integrative thinking, and emotional control. Tests such as the Bender Motor Gestalt and the Graham-Kendall Memory-for-Designs are useful in determining whether the patient's visual-motor coordination and accuracy of perception are similar to the patterns which are characteristic of individuals with cerebral damage. Subtests of the Wechsler Adult Intelligence Scale (WAIS) such as the Block Designs and the Digit Symbol Substitutions are useful in providing supporting evidence along these lines. These two sub-tests and other sections of the WAIS, such as the Similarities, Arithmetic Problems, Picture Arrangement and Object Assembly, provide data for judging whether the patient handles problem solving, abstraction and integrative thinking in a typically brain-damaged fashion.

The Rorschach is another valuable test with respect to gauging the perceptual functioning and integrative thinking characteristics of the patient. It also provides evidence regarding the quality of the individual's emotional control, as compared to what individuals with cerebral injuries show.

The behavior of the patient during the testing is an additional important feature of the examination for evidence of cerebral dysfunctioning. Indications are looked for with respect to his impotence and perplexity regarding difficulties he may be experiencing in handling what may appear to him to be relatively simple tasks which he feels he was once able to do. He is also observed for a tendency toward very concrete or simple-minded thinking, a characteristic which would be particularly significant in an individual whose education and accomplishments show advanced or mature intellectuality.

All the intellectual, personality and behavioral materials are used by the clinical psychologist in a composite fashion to distinguish between possible brain damage and psychiatric disorders. Of course, both features are present at times. An attempt, however, is made to clarify, if possible, which of these is the primary diagnostic feature.

Social Adjustment Problems

1. *Vocational rehabilitation.* Accidents and severe illness in middle-aged and aged persons often result in questions as to their suitability for returning to their regular employment. When they are no longer able to work effectively at their usual type of job, it becomes important to evaluate their residual capacities and personal-social characteristics with a view to helping them achieve adequate vocational rehabilitation. The physician would, of course, normally refer the patient to an appropriate agency within the community for the working out of such a problem. He might, however,

require a psychological evaluation prior to making such a referral in order to have an objective basis for counseling with the patient along these lines. The psychological examination would then involve:

a. gaining a conception of the patient's vocational abilities and functioning prior to the illness;

b. evaluating his present levels of performance in a variety of intellectual, psychomotor, mechanical and other aptitude areas;

c. exploring his patterns of interests, motivation for rehabilitation and for work; and

d. analyzing his personal social characteristics and their relation to adaptation to various job situations.

Information on the patient's education and job history would normally provide a useful picture of his preillness abilities. Some aspects of the intelligence test, such as the Information and the Vocabulary subtests of the WAIS, also are helpful in this respect.

Present capacities would, of course, be evaluated with the other sub-tests of the WAIS, along with specific achievement and aptitude tests, depending on which kinds of abilities are appropriate to study. Reading, spelling and other basic academic skills can be evaluated with a test such as the Stanford Achievement; mechanical knowledge and skill with the Bennett Mechanical Comprehension and the Bennett Hand-Tool Dexterity Tests; grasp of spatial relations with the Minnesota Paper Form Board. There are also various kinds of other aptitude tests in such areas as art, music and language which may be used when appropriate.

Patterns of interests can be explored by means of a test such as the Strong Vocational Interest Inventory or through a general discussion with the patient of his interests and activities. The interview is probably also the most effective method for gaining a concept of his motivation for rehabilitation and work.

Since job adjustment is dependent also on personal-social characteristics, tests such as the Minnesota Multiphasic Personality Inventory (MMPI) and a Sentence Completion Test can be used to provide information along these lines. Observations of the patient's adjustments during the testing and the interview regarding his past history and present orientations are also significant means for learning about his personality.

When all of these data are integrated by the clinical psychologist, the resulting report should make available to the physician some useful guidelines for counseling with the patient about vocational and other areas of social adjustment.

2. *Family and social relations problems.* The physician is likely to find many of his patients, particularly those beyond the retirement age, experiencing much unhappiness and anxiety related to feelings of social isolation. Changes in status, functional role and patterns of activity which take place after one's children are grown and independent, and after one has retired from regular employment or business activities, as noted in the earlier discussion, produce a disturbing sense of insecurity and uncertainty, unless one has a clear-cut new program of activities and relationships available. Often it is hard to find such new patterns of functioning. Confusion, discouragement and unhappiness may then be generated. Many aged people tend to withdraw into depression and isolation. Others overemphasize illness and become demanding of excessive attention. Still others display annoying aggressiveness and hostility toward family and friends.

Frequently, actual illness brings such problems to the physician's attention. Very often, too, the physician is one of the first consulted on the matter even when illness is not involved. As with other personal-social problems, referral to an appropriate social welfare agency can be made. Such a referral, however, may not be feasible at times, or even necessary, if the physician can gain a clear enough understanding of the problem to provide realistic counseling. Should the problem, of course, turn out to be complex and resistant to his guidance, referral to a more specialized service would then be desirable. Psychological study can provide much of the data which would help with the counseling and decision-making processes.

Examination by the psychologist would focus on the following areas:

a. the patient's mental abilities and responsiveness to intellectual stimulation;

b. the presence of special skills and/or aptitudes which could be used for vocational or hobby activities;

c. his general personality makeup and conception of himself;

d. his personal and social interests and activities;

e. his orientation toward members of his family and their attitudes and behavior toward him;

f. his outlook toward and wishes for the future;

g. his motivation for and ability to move toward new interests, activities and social adaptations; and

h. his possible need for psychotherapeutic or other specialized psycho-social services.

Data for most of these areas would be derived from such tests as the WAIS (mental abilities and intellectual responsiveness); mechanical and other appropriate types of aptitude tests; Cattell Personality Test and Sentence Completion Test (personality makeup, self-concept, significant attitudes toward the environment, motivation toward learning new ideas and skills); Kuder Preference Record and an Activity Check List (interests and ways of using time and energy at present); interview of patient and group discussion with patient and his immediate family members. The interview and group family discussion provide important information on family member interaction, especially with respect to the ways in which the patient adapts himself to the social structure of the family.

In his report, the clinical psychologist would make available to the physician a descriptive analysis and integrated summary of the test and interview data. Included would also be an evaluation of the complexity of the situation, an enumeration of the assets, strengths and weaknesses of the patient with respect to his personal-social adaptability, and recommendations for dealing with the problems presented.

Therapeutic Problems

Assets For Therapy

Decision making regarding the kinds and extent of social and psychological therapy to be provided for the patient must take into consideration such factors as ability and willingness to cooperate, adaptability to new experiences, capacity for self-evaluation and understanding of others, objectivity in facing realities of life and the environment, as well as mental and personality characteristics associated with adjustment to problems and new circumstances. Similar features are also involved in considering the patient's assets for medical rehabilitation therapy. Information along these lines would prove useful to the physician in directing his patients and their families toward appropriate help.

Such help would range from relatively simple reassurance that all will be well in the long run, to a complex treatment program which might combine drugs and physical therapy with formal psychotherapy and social service counseling. Moreover, the information on the patient's assets for therapy would enable the physician to integrate and balance his treatment efforts with those of other consultants (e.g., psychiatrist, physical therapists, speech therapists, family service agency, recreational social worker) to whom the patient might be referred.

The psychological study would, of course, be adapted to the specific problems confronting the patient and the questions raised by the physician. In most instances, the following types of tests would make up the minimal battery: WAIS for general intellectual capacities and quality of present understanding, learning and reasoning abilities; Bender Motor Gestalt for clarification of quality of perceptual abilities, visual-motor coordination, and ways of approaching and organizing one's work; Sentence Completion Test for exploring such matters as the patient's motivations for rehabilitation, conceptions of himself, attitudes toward his environment and outlook toward the future; Life Satisfaction Scale to measure morale and orientation toward the problems of living; and Rorschach to provide data on the patient's personality structure and functioning, particularly with respect to reactivity to various kinds of stimulation, use of imagination, energy for coping with experiences and ability to organize and conceptualize ideas.

The interview, in addition, would serve to elaborate on the patient's responsiveness to interpersonal relationships, ability to exercise initiative, extent of his interests and activities, and attitudes toward and readiness for self-help, as well as accepting and utilizing help offered by others. In organizing and integrating the data derived from the tests, observations and interviews, the clinical psychologist may be expected to offer specific suggestions as to the kinds of social and psychological therapy the patient is capable of responding to constructively. Descriptions may also be offered as to how he should be approached, what circumstances would be likely to stimulate and produce a positive response, and the kinds of conditions and situations which might deter therapy.

Results of Therapy

Followup is an important and extremely useful feature of a therapeutic or rehabilitation program. Too often it is neglected, thus making it difficult to gauge the results of the treatment. Serious limitations are then also placed on desirable modifications of treatment in line with changing circumstances which may further improve or prevent regression.

An area in which repeated psychological testing is especially useful is related to neurological problems, particularly those involving mental and psychomotor functions. Stroke patients and those being treated for

deteriorative CNS diseases can be evaluated for the degree of loss or extent of improvement over a time period by means of such tests as the WAIS, the Bender Motor Gestalt and the Rorschach Psychodiagnostic Test. Increase or decrease in Intelligence Quotient (I.Q.) is an important indicator of the extent to which the patient may be responding to treatment. The WAIS and other forms of intelligence tests can provide objective evidence along these lines. Recovery of visual-motor functioning would be measured by the Bender test. The Rorschach would provide evidence on gains in such areas as personality integration, perceptual and abstraction abilities, use of imagination and adaptability to problem experiences. Other tests may be used, depending on what areas of mental and personal-social functioning it may be considered useful to measure.

Mainly, however, it seems important to obtain a baseline psychological evaluation of the patient as early in his illness as possible. If a psychological study has been done prior to the illness, this would be particularly valuable. In any event, the repeated studies should enable the physician to evaluate the effects of his management of the patient and thus provide him with a basis for decisions regarding modifications in the treatment program and the need for referral to other diagnostic and therapeutic facilities.

Psychiatric, psychosomatic and general social problems which are treated by the physician are another broad and significant area wherein followup or repeat psychological testing may be deemed as important and useful. Usually it is advisable to reexamine the patient with the same or alternate forms of the tests used in the original diagnostic study. At times, however, other or additional tests may be introduced when new areas of information are desired. The comparisons which can be made between responses and patterns of reaction of the patient at different time intervals should serve as a helpful basis for judging how he is dealing with his personal, mental and social problems and the extent to which he is utilizing his therapy program constructively. When therapeutic failures are present, reexamination may be able to provide information on why the patient has not responded favorably. New leads may also be forthcoming as to modification in the therapy which might improve matters.

CASE STUDIES

Summaries of case studies involving the use of psychological examinations are offered to provide concrete indications of how the physician and the clinical psychologist may be able to work cooperatively.

CASE NO. 1: DIFFERENTIAL DIAGNOSIS BETWEEN BRAIN DAMAGE AND PSYCHIATRIC DISORDER

Mr. A., age 64, was referred for psychological study because of his high state of tension and anxiety associated with increased complaints about not being able to handle the responsibility of his job. He had worked as a leather cutter for about 20 years and managed his work well until recently, following an operation for a subdural hematoma. The operation had been performed successfully and he was reassured by the neurologist that he had no significant neurological damage. Yet, he experienced a strong sense of impotence in handling the visual-motor coordination tasks of his job, and expressed overwhelming fears of physical and mental deterioration. His physician, in referring him for a psychological study, wished to know whether Mr. A. was intellectually capable of managing his job and daily experiences, whether there was evidence of brain damage in his intellectual and visual-motor test performance, and whether there was any significant pathology in his personality functioning.

The psychological examination report noted the following features of Mr. A.'s behavior: Mr. A.'s manner reflected very marked depression both with respect to his outward behavior and his verbalizations. He complained throughout of inability to function but yet cooperated well and gave adequate attention and effort to the tasks at hand. No actual crying was shown, but he often seemed on the verge of tears as he talked of his feeling that he could not do his job adequately. When questioned specifically as to whether he was told by his boss that he wasn't performing satisfactorily, he reported that he had not been told this definitely but that he was sure this was being said behind his back both by the boss and his fellow workers. In handling the writing, drawing and other visual-motor tasks, Mr. A. expressed impotence and certainty about his failures. Insofar as the examiner could observe, however, no difficulty was experienced in carrying through the various test procedures.

With respect to actual test performances, the report goes on to say that Mr. A. displayed average intelligence (IQ 95 to 105) for his age on the WAIS. Inconsistency in quality of performance was

observed which seemed related to emotional blocking and disturbing insecurity feelings. Some aspects of his performance suggested that his capacities are probably in the high average range (IQ 110 to 119). None of the response patterns on the WAIS was similar to those of patients known to be suffering from cerebral damage. This was further validated by his fairly good-quality performance on drawings of the human figures and on the Bender Motor Gestalt Test. Visual-motor coordination and perceptual functioning, in fact, seemed above average for his age.

The outstanding features of Mr. A's test performance were his overwhelming anxiety, depressed feelings, self-devaluation and poor emotional control. Concrete questions produced reality-based responses. But when faced with more loosely structured stimuli such as the Rorschach Inkblots, he displayed confusion, disorganized thinking and poor contact with reality.

Generally he feels unable to exercise initiative and self-direction. His view of himself is of someone who has lost his bearings in a hostile, dangerous world, with few people or things to give him support and direction. He is, thus, inclined to cling desperately to his family and to demand protection and care. Regression to infantile, dependent behavior is shown, along with hostile suspiciousness toward his environment, lest his few supports be removed. He feels almost totally deprived of his masculinity.

Diagnostically Mr. A. may be regarded to be seriously in the grip of a schizo-affective reaction, with paranoid and depressive features being abundantly evident. It seems likely that the head surgery precipitated this reaction, but its basis is actually a long-standing pattern of personality pathology. Psychiatric attention is called for in this case, as soon as it can be arranged. Mr. A. is fearful of asking for such treatment, but he would probably welcome it.

The family physician took prompt action, following receipt of this report to refer Mr. A. for psychiatric attention. Relatively early intervention, it is felt, averted a complete emotional breakdown with its consequent difficulties and embarrassment to all concerned. A combination of psychotherapy and relief from environmental pressures for a time period helped the patient regain ego control and sufficient self-direction to return to his job and to live peacefully with his family. Following this, the family physician, after consultation with the psychiatrist, provided appropriate tranquilizer drug therapy.

CASE NO 2: DECISION AS TO APPROPRIATENESS OF APPLICATION TO A HOME FOR THE AGED

The physician is frequently faced with the task of helping his patient with the decision about applying to enter a home for the aged. When the patient requires close and constant supervision and care for physical and personal needs, there is little doubt as to the desirability of an institutional type of setting. The decision is more equivocal, however, when the patient has considerable residual capacity for self-care and community living but yet is seeking institutionalization. Such cases generally require careful evaluation and consideration of the various facets of the patient's physical and personal-social status before proper guidance can be offered. The psychological study can be quite useful to the physician in supplementing his physical findings and in orienting himself to the patient's needs.

A fairly typical case is that of Mrs. B., who sought to enter a home for the aged because of ambulation difficulties and some temporarily distorted vision following a cataract operation. Despite being 80 years old, she was generally in good health and previously had shown considerable independence of functioning. Her family was inclined to encourage her toward institutional care.

The physician's medical study revealed that she had no serious physical defects which might require full time supervision. Obesity was moderately severe, as was her hypercholesterolemia. Hypertensive cardiac disease was present but mild, and her functional heart classification was II. Bilateral vision, with correction, was 20/30, and the previous complaint about distorted vision was now improved. No clearcut basis for the poor ambulation and fear of falling was uncovered. Mild to moderate arthritis of the right knee and spine was present, but this was far from enough to account for the complaint. Accordingly, the physician concluded that Mrs. B's walking difficulty was psychosomatic. He also questioned her motivation for seeking institutionalization, since this was out of character with her previous orientation toward independence. Since Mrs. B. could not offer a satisfactory rationale for her actions, he referred her for psychological study.

The following excerpts from the psychological report throw some significant light on the situation.

Behavioral Observations: Mrs. B. cooperated with the examiner but acted as though she was being tolerant rather than strongly motivated to perform at her best levels. She made negative comments about the "stupidity" of some of the intellectual and questionnaire personality tests. There was no resistance, however, to completing them, though stubborn refusal to give more than perfunctory, superficial responses to the projective tests was displayed. She was obviously anxious and threatened by the unstructured quality of this experience and was visibly relieved when the materials were removed.

Outwardly, on the whole, Mrs. B. was friendly and pleasant mannered. She enjoyed the attention she received, responding particularly well to praise, appreciation and encouragement. At the slightest opportunity she was extremely loquacious, appearing to be hungry to talk about herself and her family. It was evident that she used the examination sessions as a means of gratifying a markedly pent-up need for interpersonal contact and self-expression.

Intellectual Functioning: Mrs. B's achievement on the WAIS was in the high average range (IQ 110 to 119), and her performances on the sub-tests were consistently at the upper average level or higher for her age. Memory for both immediate and remote materials was adequate. She also showed good ability to learn new information and ideas. Despite her history of visual problems, she performed well on the perceptual and visual-motor tests. Geometrical figures were copied accurately and her interpretations of pictures and images were reality-based.

Conscious Attitudes: Mrs. B. does not complain of leg pains, but she is in fear of attempting to walk without support. Despite reassurance by her physician that no physiological basis for this can be found, she does not feel that anything can be done about her condition. It sounds as though she does not want anything done, and that she derives significant secondary gains from her presumed incapacity.

In responding to questions about her life she showed general satisfaction about her earlier years. At present, however, her Life Satisfaction Scale score is below the mean for her age and she expresses intense feelings of loneliness and social isolation. Mrs. B.'s participation in family activities has decreased very dramatically in comparison with previous involvements. Moreover, she has imposed limits on her own interests and activities, as though she wished to emphasize her pathetic isolation and sense of uselessness.

Personality Functioning: A markedly psychoneurotic pattern is revealed by Mrs. B. in her reactions, characterized by depression, avoidance, affective repression and hypochondriacal exaggeration of her physical symptoms. She is in good contact with reality and able to reason quite effectively. Withdrawal from stimulation, however, is shown, so that she prevents herself from achieving satisfactions from available resources and thus dramatizes her unhappiness with her status. An abundant anger is experienced toward her family, but this is internalized and outwardly denied. The responses to the projective tests which were given, revealed an intense desire for attention, support and recognition.

Diagnostically it appears that Mrs. B. is in a depressed state and generally using psychoneurotic mechanisms to cope with her problems. She appears to be attempting to show her family that she wants to be cared for, helped to feel needed and effective, and given abundant attention and affection. Her application for institutionalization would seem to be an angry gesture calculated to dramatize her isolation and sense of being discarded. At the same time, it may represent a kind of insurance that she will be cared for and given some sorely-needed attention.

Recommendations: (1) go through with application, but, if approved, Mrs. B. should have herself placed on a deferred list; (2) referral to a Family Service agency for counseling about her personal and family relations problem; (3) physical therapy for her walking problem; (4) encouragement of an activity program to help her out of her social isolation and sense of uselessness.

Mrs. B.'s physician followed through on these recommendations. He, himself, provided her with considerable supportive psychotherapy, and arranged for her to have physiotherapy. She completed the application to the home for the aged and was placed, at her request, on the deferred list. Personal counseling was provided by the Family Service agency to which she and her family were directed. The family was helped to understand the dynamics of Mrs. B.'s behavior so that they could modify their rejective orientation somewhat and be more attentive toward and involved with her. Mrs. B., moreover, was gradually enabled by the case worker to move toward activities in the com-

munity such as attendance at a Golden Age Club, participation in group psychotherapy sessions at the agency, and visits with various relatives and acquaintances. Her interests in reading, TV and sewing were revived and used by her with much satisfaction.

A followup reevaluation a year later, showed that Mrs. B. was still pleased to be on the deferred list of the home for the aged. She had been offered a bed at one point, but had indicated she preferred to remain in her apartment, at least so long as her general health continued to be good. She no longer had the ambulation problem and complained very little about her health. Tests showed an average score for Life Satisfaction, and much less in the way of a sense of social isolation on her part. She felt that rapport with family was better, but far from what she wanted it to be. Personality functioning still showed marked psychoneurotic tendencies. However, the depression was gone and so was the sense of uselessness shown a year earlier.

THE CLINICAL PSYCHOLOGIST AS A MEMBER OF THE MEDICAL TEAM

Experience demonstrates that the diagnosis and therapeutic management of geriatric patients are complex matters requiring the cooperative interaction of an array of professional workers. The clinical psychologist can join with the physician and associated specialists as a member of the medical team. Psychological tests and systematic observations of the behavioral and emotional patterns of patients are among the significant contributions which he may bring to the diagnostic study. His clinical judgment and impressions may also prove to be a valuable resource. Associated with these factors are those recommendations he is in a position to make, regarding methods and procedures for dealing with the intellectual, psychomotor, social and personality problems which may be affecting the patient's physical and mental health. These matters have been described and illustrated in the above discussion.

It may be useful to the physician to be aware, additionally, that the clinical psychologist has training and experience in the fields of psychotherapy and research. Both of these areas are proving to be of considerable importance in the rapidly growing field of geriatric medical practice and are being included in the programs which are being developed by hospitals and medical centers.

Individual psychotherapy and personality counseling have not, so far, been very widely practiced with elderly patients, particularly when long-term considerations have been involved. Reports are appearing with increasing frequency, however, to the effect that trial efforts in dealing intensively with the intrapsychic conflicts of aged individuals are producing encouraging results with selected cases. Essentially, this is not different from what occurs in the application of psychoanalytic techniques and other forms of intensive psychotherapy with younger age agroups.

Probably more suited to the situation with aged patients may be the short-term types of individual and group psychotherapy and counseling which clinical psychologists are trained to administer. This may involve: approaches such as ego support or encouragement; advice or guidance with immediate personal problems along specific lines; education about areas of interest or importance to the patient; training toward mastery of specific skills; conditioning the individual toward certain attitudes or viewpoints; habit training; desensitization with respect to certain fears or unpleasant experiences; and discussions of life problems which include interpretation of and recognition of feelings, as well as psychoneurotic defenses. Generally, these are areas in which the clinical psychologist may also work cooperatively with the psychiatrist and the social worker, as well as other members of the mental health team.

Participation in the research functions of the geriatric medical center is a role which the clinical psychologist is also trained and disposed to carry. Pressures to provide services often lead to neglect of research designed to evaluate these services, as well as to develop new areas of knowledge and techniques of diagnosis and therapy. Fortunately, gerontologists and physicians have recognized the seriousness of this matter and are combining forces to try to develop well-balanced programs of service and research. The psychologist is equipped to take a leadership position; as well as to cooperate with a team of allied researchers to formulate hypotheses, develop research designs or strategies, gather and quantify observations, analyze data and derive conclusions which may lead to new and productive theories of the aging process.

Much of the significant research in gerontology related to mental health and psychosomatic medicine of the past few decades has been an outgrowth of the efforts of psychologists and sociologists combining their efforts and resources with psychiatrists, internists

and biological scientists. The physician, accordingly, has a willing and active team of professionals to help him provide a high calibre of service to the aged patient. It is anticipated that their combined efforts will continually improve both the practice and science of geriatric medicine.

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SECTION C/ASPECTS SPECIAL TO THE ALLIED HEALTH PROFESSIONS

Part XVI/Dentistry

DENTISTRY FOR THE ELDERLY IN HEALTH AND ILLNESS

By

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INTRODUCTION

It is difficult to realize that dentistry began to assume its role as a health profession only a little more than a century ago. The first attempt was made by a few dedicated practitioners in the early nineteeth century, but their efforts were thwarted by the proprietary schools, poor dental materials and crude equipment. Eventually the first ethical dental school in the world was established in 1840 in Baltimore, Maryland; the hand drill was replaced by the foot engine in 1871; the use of the X-ray was introduced into dentistry a few months after Roentgen's discovery in 1895; and novocain became the local anesthetic of choice in the early 1900's. Dentistry began to be practiced as a biologic science, as well as a mechanical and cosmetic art.

Perhaps the most important factor in the recognition of dentistry as a health service and of the dentist as the mouth physician was the realization that the mouth is an integral part of the body entity, and that oral disease or discomfort may be the cause or the effect of a disorder in another part of the body. The dentist became aware that although his success depends to a great extent on skill, his manual dexterity, he had to know the tissues into which, and upon which he placed his restorations, prostheses and other appliances, and he had to be aware of the fact that the prognosis of his treatments depended on his deep understanding of the total patient of whom those tissues were only a part.

Included in the patient's totality are his heredity and environment, his vocation and avocations, his family and social life, his cultural and financial status, his moods, thoughts, loves, hates, and even his religion and his politics because when he enters the dental office, he brings his vast totality with him and all of it sits down with him in the dental chair.

Should any one of the components of his totality be out of kilter (it may be his miserable job, a sickly child at home, his too-slim bank balance), the imbalance may be reflected somewhere in his physical or psychologic makeup. Where? Nobody knows just exactly where, but the dentist does know that the mouth is one of the most sensitive parts of the body, and when he examines it clinically and roentgenographically, it may actually reveal important clues with regard to the diagnosis, treatment plan, prognosis and patient management. When a protruded silent tongue is observed, it is talking; when a dental roentgenogram is studied, there is a sound tract along its edge ready to be heard —but alas, the language is still a strange one.

When the principles just expounded are applied in clinical dentistry to elderly patients, this population segment becomes much more interesting and challenging than it was in previous years. In 1900, which is less than a lifetime ago, there were only 3 million people in the United States who were 65 years of age and older, and they constituted 3 per cent of the total population. By 1965 they had increased to almost 19 million, and there was 1 of them in every 10 of the population. Their number is increasing as the population "explodes," and it has been estimated that there will ultimately be about 12 per cent of the population who are over 65.

THE OLDER PATIENT—HIS GENERAL AND ORAL HEALTH

The Healthy Aged

A large number of older people are well-preserved

physically and emotionally. They are vigorous, alert, active, economically secure and, like the senators of Roman days, they are respected in the community. If they are no longer employed, their retirement, in most cases, was of their own choice and they enjoy it to the full. Their health is good and when illness does occur, they can afford the best of medical attention in addition to what their insurance and the government provide. For such hardy individuals; aging is a stage in their development and it has no resemblance to disease or disuse.

This segment of the population receives little attention in the literature compared to that given to the chronically ill and aged, mainly because their mild infirmities are of the subclinical variety. However, they do show some benign regressive changes with aging, a state best described as senescence in the true sense of the word. Many of these signs and symptoms are so familiar that they are acceped as normal for the elderly. We take it for granted that hair becomes gray or is lost, eyes become presbyopic, hearing becomes somewhat dulled, perception slows and in general, activity becomes retarded—perhaps a protective attribute. The skin becomes dry, thin, pigmented and wrinkled. Muscle incoordination is noticeable in the gait and in various manipulations. There is often a tendency to stoop, probably because of more or less osteoporosis of the spine and the shrinking of the intervertebral disks.

The hardy ones may also experience some mild psychologic senescent changes. It has been stated, although it is not universally accepted, that loss of immediate memory and recall of distant episodes are the first evidences of advanced aging. It is possible that little strokes during sleep reduce the quantity and quality of the blood in the cerebrovascular circulation. The slight hypoxia is enough to destroy some of the brain cells. Dead brain cells are never replaced, but there are so many of them that the loss of a few is not considered serious.

Fortunately, all the cells, tissues and organs of the body do not age at the same time, or at the same rate, or in the same way in almost all people. Many of the hardy ones are alert to the benign changes, and they adapt themselves so quickly and well that impending or occurring changes are regarded as a challenge, and the little victories have a stimulating effect.

The healthy aged also know about oral health. They are familiar with geriatric dentistry from the everyday means of communication and from their dentist. They do not subscribe to the "dental fatalism" that their ancestors believed in, nor do they agree that teeth are only expendable appendages. It is possible that before long we will have a generation of old people who drank fluoridated water when their teeth were developing in childhood; also their dentist may have given fluoride treatments to their young teeth. If they kept their mouths in good condition, and if they also followed instructions about home care and proper diet, they very probably have good teeth in their later years and they want to keep them for the rest of their lives.

But oral tissues, like the rest of the body, undergo aging changes and they affect the occlusion, the teeth, the oral soft tissues, saliva, the perioral skin and muscles and the entire stomatognathic system, as we shall see in later paragraphs.

The Chronically Ill Aged

At the extreme end of the spectrum of the aged population, changes are observed in people who are really aged and sick. They are chronically ill, physically and emotionally, with every characteristic of senility. They have poor resistance to disease and to all the stresses of their environment, despite the need for some stress to promote living. Like their hardy counterparts, they do not manifest aging changes simultaneously in all their cells, tissues and organs; unlike their counterparts, however, they cannot adapt themselves even to mild differences in their metabolism or mode of life. In fact, these individuals resist change, whether it be in food, clothing, housing, or in their dental economy. It is important to keep in mind that some of them were at one time among the hardy individuals.

It is difficult to insist that their aging is a stage in their development. If their aging process is not a disease in itself, it is generally associated with many illnesses. They are subject to heart disease, cancer, cerebrovascular accidents, hypertension, atherosclerosis, nutritional diseases, pulmonary and respiratory disorders, arthritis, diabetes, influenza, the effects of accidents and several other pathoses; and it is no consolation to them that these diseases also occur in children. For our purpose, it is interesting to note that while these diseases have an acute character in children, they assume a more chronic and much less dramatic form in the old individuals. This tendency toward chronicity in the pathoses of the elderly is an observation of basic importance and is destined to assume great impact in geriatric dentistry.

Some of the old and broken people also suffer from

mental deterioration, which in the advanced stage is known as the chronic brain syndrome. Actually the retrograde psychologic change, even in its early stages is an involution, a regression to a more elementary state known in the vernacular as second childhood. Involution is the antithesis of evolution. In everyday medical practice, involution is recognized somatically as the sequence of the reduced function of the endocrine glands, which may also account for several oral pathoses as we shall see later. Several investigators also maintain that the obtuse angulation of the edentulous mandible is another physical example of an involuntary regression similar to the shape of the developing lower jaw in the fetus.

While all the physical and emotional infirmities mentioned are common among the elderly who are indigent, uneducated and disadvantaged in every respect, they are not unknown among the wealthy even though they have lived wisely and well all their lives, until their health deteriorated.

Statistics show that only 4 percent of persons over 65 are institutionalized. That means that 96 percent of the aged are in the community and when dental treatment is needed, they will visit a private dental office or a public dental clinic. In some States the indigent elderly are receiving dental service in a Medicaid program, and according to present trends we may well expect that in the near future all institutions that care for the elderly and are supported by public funds will have to be equipped with well-organized dental clinics.

The old broken individuals also have their own peculiar oral disorders. Their masticatory apparatus is insufficient or inefficient and, as a consequence, they eat only soft and fluid foods, refined carbohydrates and low residue edibles. Constipation ensues and cathartics are used to obtain relief. Vitamins A and D, which are oil-soluble, are lost when mineral oil is used and much of the nutrients in food are forcibly excreted by the action of laxatives.

Manifestations of vitamin deficiencies are seen in the mouth, the worst being a glossodynia in which taste sensations are perverted. When the sensation of sweet is depressed, the elderly person tends to indulge in an excess of sweets which, if teeth are present, contributes to decay. The empty calories cause obesity, which is a hazard in heart disease and diabetes, in addition to destroying the appetite for nourishing food. In later pages we shall enlarge on stomatodynia and glossodynia and consider the postclimacteric syndrome and its correlation with oral pathoses that are attributed to a deficiency of the sex hormones, estrogen and testosterone.

Varied Effects of Aging on Oral Health

In considering the oral health of the elderly people in our population, it is not enough to study only the hardy ones and the broken ones at the two extremes of the spectrum of aging changes. In the vast intervening area, there are millions of old people with every shade of health and illness, and their mouths show the signs and symptoms of every stage of oral senescence.

Among them we must include many who were formerly hale and hearty, but now find their muscular movements are not as supple as they used to be. Masticatory force is considerably reduced, even if a person has his own teeth. Gastric juice is not as acid as it was in earlier days and the digestive processes are less efficient. An acid medium is necessary for the proper metabolism of Vitamin C and calcium; tissue edema, bladder dysfunction, anorexia and weight loss become more evident.

When the "in-between" people find it necessary to consult a dentist, he must acquaint himself with their aging changes and remember to look for concomitant evidence of senescence when he examines the mouth. The dentist will, no doubt, be surprised to find that no two elderly persons are alike from a dental point of view, and that an old person is no more a secondhand copy of a younger one than a child is a vestpocket edition of an older individual. Every person is the sum total of his experiences in life but there are no two people who have participated in the same incidents in their time, and those who are now living longer are accumulating experiences that make each old person different from every other one.

Hence, every old person who seeks health care, general or oral, must be treated as a particular individual. Two people may have the same signs and symptoms of a morbidity so that the diagnoses are identical, but the treatments may not be the same. In cases where the treatment is the same, the prognosis may be different for each patient because of differences in metabolic processes.

INITIAL PATIENT CONTACT

The Dental Office

Let us, therefore, visit a dental office where geriatric dentistry (gerodontics) is practiced as a biologic

science and see how the patient must be thoroughly understood before the mouth is examined.

The reception room must be modified for the convenience and safety of old people. They become uncomfortable if the temperature recording in the room varies too greatly from the outside reading. The seats should be more of the kitchen rather than the living-room type, so an old person does not have to struggle to get out of one of them. Extra illumination should be provided, and the reading matter must be conservative. The floors and the floor covering should not impede ambulation, and there should not be any low tables or stools over which one might trip. Several firm objects should be placed strategically to provide support for those who do not have a steady walk.

Clues Gleaned From Appearance and Actions of Patient

As the patient enters the dentist's operatory and appears in the doorway, the dentist should automatically and in a glance observe his constitutional integrity, posture, facies, complexion and grooming.

Many elderly tend to become obese. If the obesity is due to an excessive intake of refined carbohydrates, the prognosis for a complete mouth rehabilitation may not be favorable because of the patient's poor oral hygiene and the cariogenicity of the diet. A much deeper concern is why the person has to resort to a dietary excess. It may be a compulsion to satisfy an emotional need for an abundance of sweets, or the sweet taste buds in the tongue may be atrophied, or the patient may have Cushing's syndrome in which protein is destroyed and the patient eats excessively to keep the tissues nourished. The possibility of obese people being susceptible to heart failure and diabetes mellitus is also a serious consideration. Conversely, an emaciated person may be expected to present oral manifestations of malnutrition or of some debilitating disease.

If a patient's skin is wrinkled and dark, the dehydration should alert the dentist to think of the effects of xerostomia, a dryness of the mouth that plagues innumerable old people.

A stooping of the shoulders may indicate osteoporosis of the spine, and if the same pathosis is evident in the jawbones, the teeth may be loose and bone resorption may prevent dentures from fitting properly. Patients who stoop also tend to protrude the lower jaw, It is an acquired posture which, according to some anthropologists, helps to balance a body that is no longer held upright.

A possible psychiatric explanation is that the protrusion is a manifestation of oral aggression against a world that has not treated the person properly, or it may be an example of involution to a childish behavior pattern expressed orally. It is also regarded as a convenience bite that increases the leverage and helps to macerate food more thoroughly. The extra force exerted by a protruded lower jaw can help to push the maxillary denture upward and a lower denture downward and set both of them more firmly in place.

Many old people have acquired a mouth-breathing habit. The mucosa of the nasal passages, like the skin, has lost much of its moisture, fat and elasticity and the epithelial covering of the turbinates can no longer warm and circulate the inspired air. It is often painful to breathe through the nose. Crusts form on the dry mucosa and the old people often pick them, instituting epistaxis. Breathing through the mouth avoids the nasal discomforts and, if the teeth are clenched while the mandible is protruded, a deep forced inspiration is refreshing to the mouth and throat.

Letting the jaw slide forward like an arm suspended in a sling that extends from the elbow to the finger tips relieves the muscles involved in the temporomandibular articulation and helps to circulate the blood that nourishes it.

A glance at the facial expression is often enough to reveal the patient's cooperativeness or his disgust at being forced by his children to visit the dentist. A cyanotic complexion may bespeak cardiac or pulmonary disease or polycythemia and warn the dentist that preoperative precautions must be taken. Pallor may be an indication of anemia that can be caused by gingival (gum) bleeding from an accumulation of calculus on the teeth that inflames the soft tissues.

The masculinized voice of an elderly woman may be one of the components of the postmenopausal syndrome, one of the most perplexing problems in geriatric medicine and dentistry. A nasality of the voice may be due to acute maxillary sinusitis which sometimes causes a severe toothache in clincially sound maxillary posterior teeth. A patient with tic douloureux usually refuses to speak for fear of precipitating a painful paroxysmal episode. In almost all cases, older people are affected, and they consult the dentist to see if any of their bad teeth are to blame.

As the patient walks from the doorway to the dental chair, his gait may indicate a systemic disorder that has oral correlations. A hemiplegic gait that is the consequence of a cerebrovascular accident foretells

that the paralyzed arm is a hazard in oral hygiene and in the management of removable oral prostheses and that lengthy fatiguing treatments may precipitate another stroke. A patient with the ataxic gait of tabes dorsalis may believe that he has a denture sore in his mouth but the dentist should think of a luetic lesion. The festinating gait of parkinsonism suggests that the "pill-rolling" fingers cannot give the mouth the care it needs. From the toe-drop walk of poliomyelitis it may be inferred that if the affliction occurred in childhood, the facial muscles may have been weakened, causing a narrowing of the dental arch which, in turn, might be responsible for a high incidence of dental caries—all of which may show consequences in the mouth of the old person.

When an elderly person seats himself in the dental chair and remains seated on the edge of it for some time before he is able to lean back, he has orthopnea probably associated with congestive heart failure. It is a definite signal that the patient must not be placed in one of the modern posture chairs in which the patient has to lie in a supine position for dental treatment. It should also be remembered that when an elderly person suddenly changes position when he leaves the chair, cerebral ischemia may ensue and cause vertigo. Every precaution must be taken to prevent the patient from falling. An elderly person's long bones are highly susceptible to fracture. The assistant should be available to help the patient to walk, get into and out of the chair, and to put his coat on.

DENTAL AND MEDICAL HISTORY

Values to be Gained from History

Assuming that the dentist wants to treat old people (some practitioners not only do not want to, but they are not suited to the task), he should begin to establish a wholesome rapport with the patient by asking, "What can we do for you?" The question, "What hurts you?" should never be asked; old people do not complain about pain as much as young patients do—they are not only more philosophic, but they have been trained in the school of hard knocks. Nor should a dentist ask, "What's the trouble?"—that is an opening that many elderly would welcome to give them a chance to ventilate their grieving and frustrated souls. But by some prompting and guiding, most of them will try to give a detailed account of their previous dental and medical history.

With a little assistance from an accompanying relative, the history as it is given, leads almost directly into the diagnosis. Everything that is worth remembering should be recorded. The masculinized voice of a postmenopausal patient, the pip-squeak voice of an old man whose vocal cords are stiffened, the garbled words of an edentulous person with atonic perioral musculature, and the whistling of ill-fitting dentures should be noted.

Allowance should also be made for the slower perception of the elderly. They hear what is said, but it takes a little longer to be recorded in the brain center and, therefore, the answer is somewhat delayed. The older individual feels more at ease when the dentist sits at the same eye level and touches his hand occasionally. The "laying on of hands" is still effective therapy if used with discretion.

Without exhausting the patience of an old person, the dentist should ascertain the dental history ever since childhood. It is important to know, for instance, whether there was a high incidence of dental caries in the adolescent years, for if there was an unaccountable episode of obesity at the same time, it might mean that hormonal influences were functioning in both instances simultaneously. Such a history may correlate with severe symptoms at the menopause. There is so much yet to be learned by physicians and dentists about the endocrine glands that one is justified to "grab at straws" in diagnosis.

Oral-Systemic Correlations of Diseases

While a gerodontist is not expected to know the physiopathology of all the diseases of old people, he must know the oral-systemic correlations of the commonest of them and how to manage the patients who have them.

Having the doubtful distinction of being killer number 1, *heart disease* should claim the dentist's serious attention. He should recognize that if an old person has dyspnea, orthopnea, edema of the hands and feet and a cyanotic complexion, he has a cardiac disorder. If he has a toothache in his clinically sound left posterior mandibular teeth, it may be the prodromal sign of an impending angina pectoris.

It is not important for the dentist to know the difference between the various heart abnormalities or to be able to interpret an EKG reading, but he should know that he must not treat a person with congestive heart failure beyond the point of fatigue, or use a local anesthetic with a high content of vasoconstrictor in a person with hypertension. The dentist should know

about the medications that are generally used in cardiotherapy. Patients with angina pectoris usually carry their nitroglycerin tablets with them, and they know how and when to use them. If the patient is on anticoagulants following a cerebrovascular accident, the dentist should not perform any treatment that involves bleeding without consulting the physician about a prothrombin time test.

A patient with a history of *rheumatic fever* in childhood should not have a tooth extracted unless an appropriate antibiotic is administered to prevent an exacerbation of the pathosis in the damaged heart valves. The danger lies in the propagation of the infection from the tooth to the damaged heart valves, especially if streptococci are involved, and possibly precipitate subacute bacterial endocarditis. Although subacute bacterial endocarditis is not common among the elderly, the use of the proverbial ounce of prevention is a good safety precaution. Medical consultation is always in order.

Hypertensive heart disease is much more common in the elderly. The blood pressure, especially the systolic, is high. The heart becomes enlarged, and arteriosclerosis and obesity make matters worse. The disease has a familial tendency, more so among the male mesomorphic types. Benign essential hypertension, in which the signs and symptoms are mild, is readily aggravated by emotional upsets unless the affected person is able to adapt himself to disturbing episodes or respond favorably to psychotherapeutic treatment. Frequent nosebleeds and dizzy spells are warning signs. The benign condition may degenerate into a malignant state and precipitate a cerebral hemorrhage. Knowing that his patient has hypertension, the dentist should resort to medical consultation before attempting any surgical procedure and he should know what medication the patient is taking. As in all cardiac disorders, the dentist should use a local anesthetic that contains a minimal effective amount of epinephrine, or none.

An interesting, even if elementary, sidelight in connection with cardiac diseases is that the blood that circulates through the heart and lungs also flows into and out of the dental pulp space and the dentist must learn to respect and preserve it.

Almost all coronary disease is due to *atherosclerosis of the coronary arteries.* Fatty deposits accumulate on the intima of the vessels, narrowing the lumen until coronary thrombosis or angina pectoris ensues.

Among the many disorders that affect the *respiratory system,* there are a few which may interfere with the dentist's clinical procedures. He should be wary of the discharge when old people cough because of a cold or influenza. Before the winter season arrives, the elderly should be advised to see their physician about precautions against Asian influenza. Old people have a tendency to hyperventilate by sighing heavily, induced perhaps by an emotional episode or to inspire more air. In hyperventilation, the lungs expel too much carbon dioxide, reducing the carbonic acid content of the blood which is necessary to stimulate normal respiration. Breathing into a paper bag and inhaling the carbon dioxide gives relief.

Acute respiratory diseases are not as common among the elderly as in younger people but when a toothache is the effect of an acute maxillary sinusitis or if red, bleeding gingivae result from an upper respiratory infection, the dentist should note the relation at once and refer the patient to the physician.

A postnasal drip, rather than decayed teeth or periodontal disease, may be the cause of *fetor oris.* A *raspy voice* may be evidence of a smoker's throat, and a physician should confirm or deny the early sign of a malignancy. In elderly people *emphysema* may be caused by the old age changes in the pulmonary alveoli and not always by the inhaling of tobacco smoke. The disease generally interferes with the patient's comfort in the dental chair. The patient develops dyspnea and coughs and wheezes. The walls of the alveoli lose their elasticity, some of them break and hyperinflation increases the size of the lungs, giving the chest a characteristic barrel-shape appearance. An important observation that corresponds to many of the aging changes in the mouth, as mentioned in this presentation, is replacement of pulmonary tissue by fibrosis.

Bodily health depends to a great extent on the harmonious chemical interchange that takes place in the kidneys but their delicate working may be upset by infection. Since one of the worst sources of bodily infection is to be found in the mouth, it follows that oral hygiene is an important determinant of general health. If all the infection found in dental caries, pulpitis, periapical pathosis, periodontal disease, stomatitis, glossitis, bone lesions, miscellaneous benign and malignant neoplasms, lichen planus, moniliasis and many, many other pathoses were spread out on a patient's chest, it would present a frightening picture. The theory of focal infection was once highly exaggerated when applied clinically and it fell into disrepute, but enough of it is left to become extremely helpful in clinical medicine and dentistry.

Medications for the Elderly

As part of the medical history, it is important to know what medications the patient is using and whether they were prescribed by a physician or recommended by a friend or a commerical advertisement. If the dentist finds it necessary to prescribe a drug, it must be compatible with those recommended by the physician.

Since the metabolic rate in old age is slower than it was in young years, the dosage should be reduced accordingly. The medications must not potentiate, neutralize or antagonize one another. Alcohol potentiates sedatives and tranquilizers. Drugs to reduce high blood pressure usually cause a xerostomia. Salicylates, if used for a considerable length of time, have an anticoagulant effect. Potassium iodide, a common ingredient in expectorants, is secreted in the saliva, giving it a salty taste. Dilantin sodium (diphenylhydantoin), which is so effective in epilepsy and is now being widely used in tic douloureux, migraine and cardiac arrhythmias, often causes a gingival hyperplasia. Barbiturates may excite the elderly. Phenothiazines, prescribed as tranquilizers, have a greater hypotensive effect on old people than on young ones. These are only a few examples of pharmacologic knowledge that a gerodontist should acquire.

There is also the problem of old people not remembering instructions. The information should be given in writing, or what is better, a younger and more reliable person should be made responsible for the administration of prescribed drugs.

The dentist should also know what nonprescribed proprietary drugs the patient is taking and he should be fully acquainted with the information given on the labels of those drugs. It may be important for him to forbid the patient to use a salicylate preparation, but unknowingly the patient buys something in the drug store that contains aspirin. A telephone call to the physician may be of mutual benefit.

By the time the dental and medical histories are taken, the dentist has had the opportunity of judging how well the patient is able to communicate and he can evaluate the patient's temperament, personality and behavior pattern—but he should also realize that the patient has been evaluating him at the same time.

It is important to point out at this juncture that the dentist has not yet examined the patient's mouth, and although only a few minutes have elapsed since the patient entered the operatory, so much of his intraoral condition is known before it is surveyed. The dentist can begin to form a syndrome, a group of signs and symptoms, that helps to establish a diagnosis when they occur together.

PRELIMINARY PHYSICAL OBSERVATIONS

When the patient is in the chair, he can be observed at closer range, but the dentist must confine his observations to the exposed parts of the patient's body. If the dentist wishes to correlate the lacy lesions of lichen planus in the patient's mouth with the characteristic violaceous papules on the body, he should ask the patient or the patient's physician. An enlarged head, as it is judged by the hat size, may indicate Paget's disease, a disorder that usually becomes evident in middle age and progresses slowly over a period of many years. The maxilla often enlarges and the first evidence may be discovered by the dentist when he notices the images of "cottonwool" bone in the dental roentgenogram. Similarly, acromegaly may be revealed by the massive appearance of the lower jaw and the increased growth of the extremities.

Sparse, coarse and crinkly hair and a boggy face, together with a slow speech and perception probably denotes myxedema, an extremely low rate of basal metabolism. The disease is also characterized by retarded postextraction healing. Hirsutism, an abnormal growth of hair on a woman's face, may be a familial characteristic, but it is seen in postmenopausal patients and is part of Cushing's syndrome.

The facial skin of elderly people generally becomes darker, drier and thinner. It loses much of its former moisture, fat and elasticity. Its vascular supply is considerably reduced, and the veins show through the thin cutaneous covering. Similar aging changes affect the oral mucosa. Argyll Robertson pupils in which there is accommodation to distance but not to light denote congenital syphilis. Concomitant dental anomalies in lues are rhagades of the lips, Hutchinsonian teeth and perforation of the palate. A plexus of venous capillaries in the cornea of the eyes, similar to the bloodshot eyes of the alcoholic (and for the same reason), may denote a vitamin B complex deficiency, and corresponding malnutritional signs may be seen in the varnished appearance of the oral mucosa and in angular cheilosis; periodontal disease is a frequent concomitant.

Paresthesias of the lip may be associated with congenital syphilis, pressure on a nerve by a neoplasm in

the soft tissues or jaw bone, a surgical injury or the many neuritides to which elderly people are subject. The vertical wrinkling of the lips that is known as the purse-string mouth (to be distinguished from the rhagades of congenital syphilis) is due to the loss of its supple elements, but in dentistry it also presages a difficult access into the mouth for various procedures; and it notifies the dentist that the vertical dimension of the lower face should not be extended to its early pattern when dentures have to be constructed.

If edema of the hands and feet is associated with heart failure or kidney disease, the dentist should not begin treatment without medical consultation. Spindle fingers are characteristic of rheumatoid arthritis; Heberden's nodes at the finger joints denote osteoarthritis. Both diseases are common in the later years and in many cases the patients have temporomandibular joint dysfunction. Club fingers may be associated with cardiac or pulmonary disease or with polycythemia, all of which affect diagnosis and treatment in dentistry. Edema of one arm and its fingers in an elderly woman is probably attributable to mastectomy in which the axillary nodes were resected. If the patient has an oral lesion that is suspected of being a malignancy, it may be metastatic from the breast malignancy, and the oral lesion should be biopsied immediately.

EXAMINATION OF THE MOUTH

With a "Let's take a look," the dentist is now ready to survey the mouth and it should be noticed as we proceed how, in numerous instances, a thorough clinical and roentgenographic oral examination may be of invaluable assistance in medical diagnosis.

Before the patient is asked to open his mouth, the occlusion (bite) should be studied. We have mentioned the acquired habit or protruding the mandible by older people, but in debilitated patients there is a tendency for the force of gravity to depress the jaw without physiologic antagonism from the elevator muscles. The facial muscles are also without expression. One can assume that the tongue lies limp in the floor of the mouth and is not able to prepare the bolus of food efficiently for deglutition. Because of the flaccid muscles, denture retention is poor and it can be taken for granted that all the other muscles of the body are atonic.

The dentist should then close his own teeth and let the patient see how he slides his mandible forward and from side to side and ask the patient to imitate the excursions. This is more effective than giving verbal instructions. The movements of the mandible must not be restricted; if they are, the cause must be investigated. Tumors, neoplasms of the soft tissues or bones or fractures may be involved.

The temporomandibular joints are then palpated for a clicking or crepitus that might be associated with a generalized arthritis or with a severe overclosure of the jaws, because of excessive abrasion of the teeth or resorption of the residual ridges of the maxilla and mandible. As the mouth is opened and closed, the dentist can evaluate the extent of the oral opening to assist him in treatment planning. A deviation of the mandible as it opens may be due to an ipsilateral accident of the jaw in childhood that temporarily depressed the growth center in the condyle. When the bone damage recovered, the slight shortening of the ramus remained as a permanent stigma and persisted into old age. The accident may also account for some other damage in the body for which no reason was known.

DEVELOPMENTAL AND OCCUPATIONAL ABNORMALITIES OF TEETH

In an intraoral survey the dentist would immediately notice the number of missing teeth, but there are some conditions in which some or all of the teeth are not seen clinically or roentgenographically. Both the primary and permanent teeth or only some or all of them may be involved. The anomalies are known as *total anodontia vera* if there is no evidence of both dentitions, not even any germs of teeth. If teeth cannot be seen clinically but are evident in the roentgenogram, it is known as *total pseudo anodontia.* The terms *partial anodontia vera* and *partial pseudo anodontia* are used when only some of the teeth are affected.

In *ectodermal dysplasia*, all the ectodermal tissues are anomalous. A few or all of the teeth never materialize; there are no sweat glands in the entire body; the hair remains lanuga-like; and the eyes are affected by photophobia.

In *cleidocranial dysotosis* the primary teeth may erupt, but some of the permanent teeth may never appear clinically although visible in the dental roentgenogram. The clavicles are absent or incompletely developed, and the hypertelorism of the eyes gives them the appearance of being set unusually wide apart. The absence of the clavicles permits the shoulders to approximate when the arms are crossed. If the clavi-

cles are not involved, the other malformations are known as *craniofacial dysostosis*. The abnormalities do not affect a person's longevity, and they are seen occasionally in old people. It is generally agreed that the unerupted teeth should not be disturbed when prostheses are constructed. The stimulation of the appliance does not cause the embedded teeth to erupt.

In juvenile rickets the deficiency of calcium and vitamin D result in a softening of the bones, and the matrix is never properly mineralized. The bones show evidence of epiphyseal growth, cranial tabes, frontal bosses, enlarged wrist and ankle protruberances, and the softening of the bones result in knock-knees or bowlegs, all permanent stigmata. The mandible is also softened and the submandibular muscles pull it downward, since the substance of the jawbone is osteoid rather than osseous. The fulcrum of the leverage is located in the lower border of the jaw and is permanently recorded as an antegonial notch which is readily palpable for life.

The distortion of the jaw results in a more or less wide gap between the upper and lower teeth; the tip of the tongue is held in the space; and the teeth never continue to erupt, leaving the bite open. When it is necessary to construct dentures for the patient in later life, the bite presents a difficult problem in oral esthetics.

In severe childhood diseases, especially if a prolonged fever is involved, the preeruption development of the dental enamel of the permanent teeth may be halted for a while. The child recovers and the developmental process is resumed, but a permanent record of the interruption is seen when the tooth erupts. It appears as a row of pits or as a band of hypoplastic enamel, and the position of the hypoplasia in the enamel records the time of the episode. The anomalous teeth may be preserved into old age. In many cases of childhood rickets, an elderly person has no recollection of the disease, but the signs disclose it.

Hutchinson teeth are assumed to characterize congenital syphilis, but only if the stigma is accompanied by the two other signs of the triad—interstitial keratitis of the cornea of the eyes and eighth nerve deafness. The anterior teeth are barrel-shaped; they are narrower at the biting edge than at the gum line, and the edge often has a deep notch. With proper care, the teeth may last a lifetime.

The teeth of elderly people should show a reasonable amount of attrition on the occluding and approximating surfaces. In fact, if they do not show some attrition, it indicates that there is no lateral excursion and the person frequently develops a temporomandibular joint dysfunction in the earlier years. He is usually the type of person who clamps or clenches his teeth, especially in sleep, and the natural tendency to want to slide the teeth may institute a periodontal disease; if no treatment is given, the teeth are lost before the patient reaches old age.

When the occlusal wear is excessive, it may be due to the more than thorough mastication of roughage in food, the sand in chewing tobacco, or to the diurnal and nocturnal habit of bruxism that is usually accompanied in sleep by a stridor. The habit is generally attributed to emotional tension, for which reason it has been designated as bruxomania.

The abrasion is responsible for the loss of cusp height which is generally compensated by the continuous eruption of the teeth which are accompanied by their periodontium. If the oral opening is restricted by the dehydration of the perioral skin and muscles, the compensatory eruption does not fully restore the vertical dimension of the lower face to its original dimension. Sometimes compensation does not occur; the lower face loses its vertical dimension when the teeth are occluded, and the face resembles that seen in Punch and other caricatures of senile people.

The teeth of elderly people become harder with age because of an increase in calcification and they lose a considerable amount of moisture. Stained cracks in the enamel of old teeth are a common sight. Cusps often break off, and roots, especially if they have been treated endodontically, may split.

There is also an increase in fluorides in the dental enamel with advancing age. They are absorbed from food and give old teeth their deeper yellow color. The fluoride content may contribute to the reduction in dental caries in the teeth of the elderly, but in the paragraphs dealing with saliva we shall see the havoc caused by rampant dental decay in the middle seventies and later.

PERIODONTAL DISEASE

In further questions about the dental history, the dentist should also ask why missing teeth were extracted. If the teeth were carious beyond repair and the jawbone was not involved, the probability is that complete dentures will give satisfaction, but if periodontal disease accounted for the edentulousness, a considerable amount of ridge resorption would follow.

Periodontal disease attacks the soft tissues that surround the teeth and the bone that supports them. It may begin in the early years and progress insidiously without pain until it becomes the major cause of the loss of teeth after middle age. The incidence of periodontal disease among the elderly is high; nevertheless, there are innumerable old people who, despite chronic illness, display a healthy periodontium.

Familial factors may defy every known cause of the disease, and heredity may offer the only reason why a person's teeth loosen although they were given proper treatment and meticulous care. Serious consideration must also be given to the interplay between local and systemic factors. Each may be a specific, contributing, precipitating or exacerbating cause.

It is not unusual for a patient to admire her teeth and gums, only to learn that the roentgenograms indicate that the alveolar bone is being resorbed, a morbidity that compares with osteoporosis of the spine.

Conversely, there are teeth with roots exposed, gingiva receded, and the supporting bone roentgenographically deficient; yet the teeth are firm and clean, and a closer inspection shows that the image of the alveolar lamina dura, the white line that surrounds the roots, is definite and continuous over the crests of the sockets, making it quite clear that nature is repairing the damage and retarding the progress of the disease.

We are thus brought back to the biologic principle that we must consider the patient who has the disease as well as the disease that he has, and that applies to all other oral disorders too.

Multiple Causes

Among the local causes of periodontal disease are deposits of calculus which encroach onto the roots of the teeth, malocclusion of the teeth, food impacted between the teeth and against the gingiva, mouth breathing, bruxism and the iatrogenic damage done by poor restorations and other prostheses.

More serious and complicated are the systematic diseases which have oral manifestations. Alveolar bone resorption may occur in hyperparathyroidism, Cushing's syndrome, diabetes mellitus, osteomalacia, syphilis, postclimacteric hormonal deficiencies, and in any disease that causes a faulty protein metabolism. The soft tissues of the periodontium are affected in the hemorrhage of blood dyscrasias (thrombocytopenic purpura, polycythemia, leukemia, hemophilia, scurvy, etc.), the vesiculation of herpes zoster, the pigmentation of Addison's disease, the bullae of pemphigus, the generalized malaise of acute necrotic gingivitis, the peeling of desquamative stomatitis, and in many of the debilitating diseases.

The effect of some drugs on the gingiva is seen in the hyperplasia of dilantin sodium, the bleeding caused by excess salicylates, and the reaction to allergenic pharmaceuticals.

When recalling the old saying about the mouth being the gateway to the body, it is not surprising to find that its tissues are subject to so many diseases.

Safeguards against Infection

Some consideration should also be given to the theory of focal infection when gingival surgery has to be performed in the treatment of periodontal disease. Whether a simple scaling of the teeth or extensive gingivectomy is done, a transient bacteremia ensues. As in the case of a dental extraction, the possibility of initiating subacute bacterial endocarditis in a patient with a history of rheumatic fever should be anticipated, although the incidence of this cardiac complication in elderly people is not frequent. It is wise to prepare the patient with an antibiotic.

Fibrosis of Periodontal Soft Tissues

The neglected periodontal soft tissues of old people often become fibrotic. Connective tissue fibers replace much of the normal gingiva by the process of anachoresis. The tissues become much paler because their blood supply is reduced and their metabolic exchange is retarded. The characteristic stippling is lost and the tissues are enlarged. The patient is satisfied that his gums have stopped bleeding, although he has neglected his oral hygiene.

Medicine knows well that a similar fibrotic process occurs in many parts of the body in advanced senescence, and although it is not fatal, it does retard the metabolic processes. If such gingival tissue is subjected to surgery, the actual cutting procedure is simplified by its gristle-like character, but the healing is delayed. There may be some truth to the statement made by some that the fibrous hyperplastic tissue hugs the teeth tightly and helps to hold them more firmly in place.

There is another periodontal condition in which the fibrosis just mentioned assumes a more beneficent role. Reference was made to it on speaking about the cementum on the roots of the teeth being exposed, but the image of the roentgenographic alveolar lamina dura is definite and continuous all around the roots and over the crests of the alveolar bone. The fibrosis is

hypovascular but the gingiva, instead of enlarging, recedes painlessly, and although the root portions of the teeth are exposed, they are clean and firm. For want of better nomenclature, the condition has been called physiologic senile atrophy, but it is a misnomer.

When the periodontal soft tissues cannot react to irritation and degeneration by fibrosis, they break down completely. The tissues become highly inflamed; the characteristic stippling of healthy gingiva disappears; lateral abscesses form; the supporting bone is lost; deep suppurating periodontal pockets are created; the teeth loosen and are frequently exfoliated. The pathogenic process, in a way, resembles what occurs when appendicitis in old people is neglected. Physicians often tell about oldsters who treat their stomach aches with cathartics and enemas, and when they eventually resort to medical consultation and the roentgenogram indicates the necessity for exploratory surgery, it is frequently found that the appendix is necrotic or gangrenous.

ABNORMALITIES OF ORAL MUCOSA

One of the constant difficulties in clinical dental education is to divert the attention of the practitioner from the teeth and the periodontium to the other mucosal surfaces in the mouth. The buccal mucosa, the inside of the cheek, is usually retracted by the dentist while he operates, and he does not give himself the opportunity of observing changes in its color and texture. The normal buccal mucosa is covered with a thin delicate epithelial lining, totally different from the tough masticatory type of tissue seen on the gingiva.

As the buccal mucosa ages, it becomes thinner, less vascular and the surface looks as if it had been varnished. It is constantly being insulted by the traumatization of foodstuffs and the nibbling by the teeth, natural or artificial. Chemicals, bacteria, polluted air and hot and cold foods injure the delicate mucosa, but in the younger years its rich blood supply affords an adequate protection.

The aged mucosa tries to react by a whitish keratosis of the epithelium which may become hyperkeratotic when the hardness is increased by a piling up of epithelial cells. This observation is of vital importance because of the tendency of aging tissue not to respond by physiologic inflammation that is protective when the leukocytes and all the other defense mechanisms come to the aid of the tissue before it breaks down and begins to suppurate.

Lesions of Buccal Mucosa

If the proliferation extends deeply into the subepithelial regions, it may be related to the initiation of a malignancy. But the degeneration process may be so slow that the cancer does not evidence any signs or symptoms in a person's lifetime and, since the span of life does not seem to be extending too far beyond the Biblical "three score and ten," the pessimistic outlook is only academic for the time being. Hence, if an octogenarian (actual case) has been an habitual smoker since boyhood, a hyperkeratotic layer on his buccal mucosa on a level with the occlusal plane of his dentures may be a protection rather than a pathosis and a biopsy is not called for. The process in the mouth may be compared with the development of a leathery skin on the palms of a carpenter's hands as a protection against the constant trauma of the hammer. Of course, it takes years of observation to be able to make such a decision.

Other benign white lesions on the buccal mucosa of old people include lichen planus, moniliasis and the so-called leukoplakia due to a vitamin A deficiency. Nevertheless, the white or gray lesion must be given serious attention, depending on one's clinical experience and willingness to assume responsibility. The cytologic examination offers some guidance, but if the lesion feels hard and has a cracked crust, one may be sure that the microscopic diagnosis will be a squamous cell carcinoma.

Cyanosis of Oral Mucosa and Pigmentation

A generalized cyanosis of the oral mucosa is seen in heart and lung diseases and in polycythemia; an anemic person's mouth shows a characteristic pallor. Brown pigmentations are seen on the mucosa in Addison's disease (hypoadrenalism), but the melanin spots are considered normal in dark-skinned people, irrespective of race. A black-and-blue swelling may be attributed to a bite, but if the purplish tumors are distributed over the mucosal surface, especially where biting is impossible, one should think of thrombocytopenic purpura.

Other Oral Landmarks and Abnormal Findings

There is one normal structure on the buccal mucosa that often confuses an observer who is not acquainted with oral landmarks—the papilla which lies over the mouth of Stenson's duct of the parotid gland. It is found bilaterally opposite the first maxillary molar, a tooth which most old people lose in their earlier years.

In the buccal mucosa of the elderly one can usually see Fordyce's spots or granules, once thought to be a disease. They are ectopic glands of sebaceous matter which gives them the yellowness of chamois cloth. They occur in the mouths of most people and present no symptoms, often spreading to the labial mucosa. Because of the thinning of senescent mucosa, they are readily visible in the mouths of old people, mostly in males.

The appearance of one or more scarlet red petechial spots on the buccal mucosa should be regarded as a danger signal and an important one. In occasional cases the red spots may be innocuous and due to a slight submucosal leakage of blood, but in most instances it signifies:

1. An abnormality of blood elements (white cells in leukemia; red cells in polycythemia; platelets in thrombocytopenic purpura).
2. An abnormality of the blood vessel walls (fragility in scurvy or even in subclinical vitamin C deficiency).
3. An abnormality in the hemopoietic system (bone marrow, spleen, etc., etc.).

Mucosa of the Hard Palate

The mucosa of the hard palate is keratinized and immovable, and it is firmly attached to the bone. Between the palatal vault and the teeth (or the residual ridge in an edentulous mouth), there are transverse rugae (ridges) of thick cornified epithelium. Where no natural or artificial teeth are present, some elderly people can mash food with the tongue against the rugae like clothes being rubbed against a washboard. The surface of the palate posterior to the rugae is smooth and contains many mucous glands.

The mucosa of the palate is subject to the same diseases that affect the mucosa in other parts of the mouth, but in addition, the palate of heavy smokers may be affected by *nicotine stomatitis*. The mouths of the mucous glands become inflamed and red, and the epithelium around them is gray and hyperkeratotic. If raspiness of the voice is a concomitant observation, the physician should investigate the possibility of a malignancy of the larynx.

Inflammatory papillary hyperplasia of the palate resembles nicotine stomatitis and occupies the same location, but it is not associated with smoking. It is said to be the result of an irritation by the relief chamber that some dentists carve into the palatal surface of a complete denture to provide a suction effect to aid the retention of the prosthesis. This is a false conception. The vacuum effect does not last long. The tissue is pulled in against the denture and becomes hyperplastic.

Whitish lesions on the palate with a red areolar border were once assumed to be herpetic lesions but recent research tells us that the *herpes simplex virus* appears in the mouth only once when the newborn child passes through the birth canal of the mother. Later it then moves out of the mouth and lodges forever on the lips, especially the lower, where it proliferates in numerous vesicles whenever the host's resistance is low. The vesicles break immediately and form a macule which is commonly known as a cold sore or fever blister.

The whitish lesions with erythematous borders seen on the palate are a form of *aphthous stomatitis*, and they occur frequently in the mouths of older people. Like the herpetic lesion, they begin as vesicles which soon break and become macular in appearance, and are generally called canker sores. They contain an L-form bacterium which resembles the streptococcus seen in pneumonia, but it probably is in a transitional stage. When the palatal mucosa is injured by a denture or by a seed or other small object trapped between the prosthesis and the tissue, it does not resemble the lesion of aphthous stomatitis. Its edge is ragged; it has no red border and is not macular. In any case, these palatal lesions should be differentiated from malignant ulcers.

Mucosa of the Soft Palate

The soft palate and its uvula are not attached to any bone. They are covered with a soft lining mucosa which has a rich blood supply. The mucous glands of the soft palate are a continuation of those found in the hard palate. In the construction of a denture prosthesis with a full palate, the dentist must use extreme care not to interfere with the free mobility of the soft palate. Abnormal movement or paralysis of the soft palate may disclose a history of a surgical procedure or of a neuropathy that has a medical history or needs medical investigation.

Oral pathoses or discomforts occasionally require some information about the oral adnexa. The fiery redness of bleeding gingivae may be the extension into the mouth of an upper respiratory infection, and treatment should be given by a physician. The inflammation in the oropharynx may readily be seen by the dentist.

When a patient complains of a fetor oris and there is no particular etiology to be seen in the mouth, the dentist may notice postnasal drip oozing down the posterior wall of the oropharynx. The objectionable odor does not always originate in the mouth; the patient should be referred for medical attention.

ABNORMALITIES OF UNDERLYING BONE

Hard Palate and Mandible

The *torus palatinus* appears to be a familial exostosis. Its onset occurs in the teen ages, mostly in females, and it grows so slowly that the patient is not aware of it. It may remain small in size or extend over most of the palate. If it is necessary to cover the entire hard palate with a prosthesis, the denture base may be modified to avoid interference with a small torus, but if it is large, surgical interference may be necessary; special care must be exercised not to involve the floor of the nasal cavity.

Tori may also grow bilaterally on the lingual surface of the mandible below the premolars. If the exostoses cannot be circumvented by a needed prosthesis, they have to be removed surgically.

Dentists are often called upon to provide an appliance to obturate a cleft palate for an elderly person or to replace an old one that no longer fits. It is important for the dentist to know the history. The cleft may be congenital or the result of an accident, but it may be due to tertiary syphilis, or it might have been made surgically for access to a neoplasm in the nasal cavity or maxillary sinus.

Maxillary Sinus and Nasal Cavity

The maxillary sinus and nasal cavity are often involved in oral problems. A patient may complain of a swollen palate, but it may be caused by a nasopalatine cyst or by a malignancy in the maxillary sinus. A toothache in a clinically sound maxillary posterior tooth may defy diagnosis clinically and roentgenographically until the dentist becomes aware that the patient has a maxillary sinusitis. The superior alveolar nerve which supplies the teeth lies in the wall or floor of the sinus and is irritated by the inflammation of the antral mucosa, causing an odontalgia.

ABNORMALITIES OF THE TONGUE

At one time in the history of medicine, the tongue was an important indicator of a patient's health, but since medical horizons have become almost limitless, the appearance of the tongue is regarded only as a minor aid to diagnosis. To a dentist, however, the tongue is ever present within his limited field of operation, and to him an abnormality of the tongue's appearance should be apparent immediately, since it is frequently a sign of a disorder with an oral-systemic correlation.

The so-called hairy tongue may indicate that the filiform papillae have become hyperplastic probably because of a local irritant, but in most cases the growth is a moniliasis, a colony of the candida albicans fungus. The dark brown or black color is from the staining of food or tobacco smoke. As a rule, the fungal propagation is induced by the depression of the other oral organisms by the administration of an antibiotic which was prescribed for an oral or nonoral disorder.

A coated tongue in itself does not indicate any specific disease, oral or systemic, although it is generally present in gastrointestinal, liver and other diseases. It usually accompanies mouth breathing or dryness of the mouth, either of which may have an oral-systemic correlation. It is not uncommon when oral hygiene is poor or if a person does not eat detergent foods.

A geographic tongue, so called because it looks like a map, is usually ascribed to an emotional episode. The atrophy of the papillae begins at the midline and wanders over to the border where it disappears. The process is repeated until the emotional and nutritional balance is restored.

In good health, the dorsum of the tongue is completely covered with innumerable filiform papillae which are covered with a hornified epithelium. Among them and at a lower level, are the less numerous and highly vascular fungiform papillae, shaped like mushrooms, and some of them harbor taste buds. Other taste buds are located on the 8 or 10 circumvallate papillae on the posterior surface of the tongue, and a few are found on the lateral border of the posterior part of the tongue and on the epiglottis. The muscles of a healthy tongue are strong and firm so that when the tongue is extended, the organ reflects a person's well-being. In poor health, the filiform papillae usually become limp and expose the heads of the fungiform papillae, or the latter become engorged with blood and their red heads show clearly on the surface of the tongue above the filiform papillae.

In many systemic diseases the tongue becomes atonic, and it lies limp in the floor of the mouth so

that its borders become crenated by the mild pressure against the teeth, natural or artificial. If no teeth are present, partially or totally, the limp tongue expands into the vacancy. When dental prostheses are provided, the tongue may regain its normal dimensions, but if it does not, the denture becomes most discomforting. The dentures have to be modified to allow room for the tongue. When an atonic tongue is protruded, it literally hangs out of the mouth. Its flaccid muscles let the tip almost touch the chin without much effort.

In other systemic diseases, the tongue becomes atrophic and it may shrink in size. The filiform and fungiform papillae atrophy, leaving the taste buds exposed. The sensations of taste are confused and inadequate for delicate discrimination. The bald dorsum of the tongue is fiery red, shiny and smooth, and it is often so sensitive that patients ask the dentist to file teeth down although they may not be sharp.

The worst symptom that afflicts the atrophic tongue is a painful burning sensation that is known as glossodynia or glossopyrosis. Not only is it the most difficult postclimacteric symptom to treat, but it also often arouses a cancerphobia. The burning sensation may also spread to other parts of the oral mucosa. Among the many causes of glossodynia are vitamin B complex deficiency, pernicious anemia, hormonal imbalance and emotional upsets, and it is usually a multicausal complexity. In too many cases the symptom is ascribed to an allergic reaction to the acrylic material in dentures, but the assertion may have validity only if the person is also unable to tolerate any of the newer textiles that are related to acrylic. Occasionally it happens that the denture was not properly processed and the free monomer in the plastic is the irritant; the denture should be reprocessed. Glossodynia is another example in which the patient, rather than the disease, needs the treatment—physical, psychologic, nutritional, medicinal, and often economic and educational.

The ventral surface of the tongue of the elderly requires special attention. The epithelium of the underside is thin, loosely attached at the subsurface, nonkeratinized and well supplied with blood, but the veins are frequently varicosed. If the varicosities are unusually enlarged, resembling hematomas, they are said by some to indicate a cardiovascular or pulmonary disorder.

Sublingual Space

The floor of the mouth (sublingual space) is covered with a thin mucosa, and it accommodates the sublingual and submandibular salivary glands. The area is subject to ranula (a retention cyst of a salivary gland), to various malignant neoplasms and to Ludwig's angina, but it does not evidence any particular oral-systemic disturbances.

SALIVA AND ORAL PATHOLOGY

Saliva deserves much more research investigation than it has received. In old age, its functions are severely curtailed in many instances, causing a considerable amount of oral pathosis.

Normally saliva is a mixed secretion consisting of a thin, watery serous fluid and a thick, ropy mucus. In old age the epithelial lining of the mucous glands degenerates and is replaced by fatty tissue, resulting in a considerably retarded flow of the saliva. The secretion of the serous glands is curtailed to a greater extent than the flow from the mucous glands, and the resultant fluid is thick and gummy.

The irrigation of food debris is thus lessened; the mucosa is deprived of the moist coating that keeps it in good condition; the bolus of food is not lubricated; deglutition is more difficult; and worst of all, the meager amount of saliva does not have enough buffering action against dental caries.

As a result, there is a tendency for the teeth to decay. The gummy saliva encourages the formation of plaques which adhere to the teeth. The plaques contain moisture, warmth and food for the lactobacilli and other acidogenic organisms to proliferate in an incubator-like environment. More acid is produced from the fermentation of debris of carbohydrate foods, thus the inorganic components of the teeth disintegrate. There are also proteolytic organisms in the mouth that attack the organic elements in the teeth.

This is an oversimplified explanation of the chemico-parasitic theory of dental caries. Other investigators favor a proteolytic theory which denies the destructive part played by acid.

The subject of dental caries has been somewhat elaborated upon because it has long been accepted that the elderly were immune to dental decay. Periodontal disease received almost all the blame for the loss of teeth in old people. That was true when most of the elderly had lost their teeth by age 60, but now that people are living so much longer, and since many of them retain their natural teeth, the reduction in the flow of saliva plays havoc with the teeth of many in their late seventies. The decay attacks the enamel of

the teeth and also the cementum covering the roots that are exposed when the gingiva recedes. The destruction spreads along the surface of the tooth, rather than into the body of the tooth as it does in young people, and it is almost impossible to repair the damage. A method of rehabilitation by the use of calcium hydroxide has been suggested for the rampant dental decay of advanced age, and some of the investigators maintain that the damaged dental tissues may be remineralized to some extent by the withdrawal of mineral from the calcium hydroxide.

The dryness that results from the reduction in salivary flow is known variously as xerostomia, aptyalism, hyposalivation and asialorrhea. Among the common causes of the condition when it occurs in elderly people are mouth breathing, nutritional deficiency, emotional upsets, diabetes, irradiation that involves the mouth, the postclimacteric syndrome, Sjogren's syndrome and Mikulicz's disease. When the flow of saliva is reduced, there is a deficiency of ptyalin, the enzyme in the saliva that digests starch in the mouth and converts it into the simpler forms of maltose and dextrose, and it is assumed that an extra burden is thus placed on the gastrointestinal digestive process. It is unfortunate that so many of the modern drugs now being prescribed by physicians, especially the antihypertensive medications, cause dryness of the mouth, but the patients bring their complaints to the dentist. Only the physician should determine whether sialogogues are to be prescribed. Local alleviation with water, flavored oils, sugarless lemon drops or other innocuous remedies may be recommended.

THE EXTERNAL MOUTH AND ADJACENT STRUCTURES

Upon leaving the mouth, the dentist should survey the lips. In elderly people they are often dry because of the loss of moisture, fat and elasticity from the tissues. The perioral skin wrinkles, giving it the purse-string appearance that is so characteristic of advanced age. The cheilosis at the angle of the mouth, which we said above indicates a vitamin B complex deficiency, may also be caused by the intermittent drooling of saliva and the drying of the skin, or when height of the lower face is reduced by severe abrasion of the teeth that is not compensated by passive eruption or by resorption of the bony ridges of the maxilla and mandible.

The vermilion border of the lip, which does not have the physiologic protective features of the adjacent skin and mucosa, is, like other transitional tissues of the body, highly susceptible to pathoses including carcinoma. Herpes, angioneurotic edema and erythema multiforme have a predilection for the lips.

Elderly patients who have a swelling of the neck sometimes assume that it is due to an abscessed tooth, and they consult the dentist. They may be correct in their assumption, because the infection from the tooth may travel through the fascial spaces to the neck, even to the chest, but the swelling may also be caused by ranula, sialolithiasis in a gland, Ludwig's angina, cervical neoplasm or a swollen lymph node associated with nearby malignancy or with metastasis from a distant one. Cervical enlargements must be palpated gently. Excessive manipulation may break the membrane of a cyst, initiate metastasis from a malignancy, or propagate infection from an abscess.

X-RAYS OF THE TEETH AND JAWBONES

A clinical examination of the mouth is not complete without roentgenograms of the teeth and jawbones. The images of the dental roots or the character of the bone may offer a clue to a systemic disorder that occurred in childhood or that is currently active or that will show clinical signs at some time in the future. Abnormal endocrine glands or calcium deficiency often prevent the roots of children's teeth from developing fully, and the stigma is recorded in the dental roentgenogram forever. Short roots in the teeth of an elderly person may be traced to childhood rickets or juvenile diabetes.

When the developing teeth of a child are in the path of X-rays used to irradiate a hemangioma of the face (strawberry mark), the undeveloped buds or the undeveloped portions of teeth may be destroyed, or the development of some of the roots may be so excessively accelerated that in later years when the history may be intentionally or unconsciously forgotten, the roetgenographic appearance of the short and pointed roots (they look as if they had been put through a pencil sharpener) becomes a deep mystery.

Rogentgenograms of the teeth of elderly people often show that the periodontal ligament space between the roots and the bony walls of the sockets have narrowed, probably because of the considerable reduction of masticatory force in old age. Normally the stress in chewing is stimulating to a tooth and its periodontium, but only if it is applied along the long axis of the

tooth. But if teeth are tipped, as they often are in the mouths of old people, the misdirected force of the bite, although it is severely reduced, destroys the structures that hold the teeth in place. The narrowing of the periodontal ligament space is regarded by some as a means of holding the tooth more firmly in its socket. They say that the narrowing of the space is not due to the encroachment of the bone but to the increase in the normal cementum on the root. Sometimes the apposition warrants being called *hypercementosis,* but it is not as bulbous as that sometimes seen in Paget's disease or in acromegaly.

Systemic Disease Detection by X-Ray

An irregular roentgenographic pattern of alveolar bone resorption may lead to the discovery of unknown diabetes in an older person. In every roentgenographic picture of a jawbone with periodontal disease, there is some evidence of an attempt on the part of nature to heal the damage that has been done; the remaining image of the alveolar lamina dura is particularly sharp or some sclerosis seems to be reinforcing the residual structure of the bone. But in diabetes, it appears that nature capitulates and is compelled to let the degeneration proceed. An understanding of the character of bone is as important as becoming fully acquainted with the character of the patient.

"Cottonwool" images in the roentgenogram of a jawbone may be the first clue to the diagnosis of *Paget's disease* in middle-aged people who would not otherwise know that they had the disease until they became crippled many years later. The "groundglass" bone and the loss of the images of the alveolar lamina dura in the dental roentgenogram are cardinal characteristics in the detection of *hyperparathyroidism* by the dentist. Severe radiolucency of the jawbone may be due to a deficiency of the estrogenic hormone and be concomitant with *osteoporosis of the spine.* The emphasis that is placed on the sex hormones and their influence on the integrity of bone and vaginal mucosa in medical literature applies also to the jawbones and the oral mucosa. The massive mandible seen in a headplate of a middle-aged person is a sign of *acromegaly* before the patient complains to a physician about the excessive growth of his extremities. *Scleroderma* is confirmed by an unusual widening of the periodontal ligament space in a dental roentgenogram, and an increase in the sclerotic bone around the space. Almost every case in which a dentist discovers a systemic disease in a dental roentgenogram is referred to a physician who, if the dentist's impression is correct, has to corroborate the findings by additional diagnostic aids. Healthy bone has a distinct roentgenographic character of trabeculations and marrow spaces according to its function. Any change in character may be a clue to a systemic disorder.

DENTAL PROSTHESIS

One cannot say too often that no dental prosthesis can be successful if the environment in which it has to function is not wholesome. A beautiful denture or a series of porcelain veneer crowns cannot be efficient if the mouth is plagued with a high susceptibility to dental caries or with periodontal disease, aphthous stomatitis, desquamative gingivitis or an insidious squamous cell carcinoma on the base of the tongue that was not discovered until it began to be painful.

Some old people have had their mouths rehabilitated in their middle-age years, and the prostheses continue to give excellent service into the advanced ages. In other cases the restorations failed because at the time that they were constructed, the probable aging changes were not noticed and the prognosis was completely overlooked. The unfortunate sequence was not due to a lack of skill but to a lack of basic biologic knowledge. The prosthesis on the plaster model was given all the attention. If some of it had been given to the patient, the prosthetic procedure would have been entirely different. Nature is generally beneficent, but when her laws are violated, some one has to pay the penalty—the dentist or the patient.

Occasionally the tolerance of the patient or of the oral tissues of an old individual is such that complete mouth rehabilitation is contraindicated. Only adequate rehabilitation is necessary, just enough to improve the function of the masticatory apparatus, the comfort of the mouth and of the oral appearance. Sometimes a dentist can do no more than remove all the pathosis in the mouth and leave the patient edentulous or provide dentures to be used only at mealtime. It takes diplomacy and courage for a dentist to perform the least amount of corrective and restorative treatment when the patient is able and willing to pay a more than handsome fee for a complete service.

From all indications, it seems that the dentist will have to take part in educating the patient in the matter of diet and nutrition. The health of the oral tissues depends considerably not only on the nutrients in the food that the patient eats, but also on its quality,

texture and digestibility and, what is most important, on the wholesomeness of the environment in which the food is eaten.

If good health depended only on the nutrients with which the body is supplied, the best results could be obtained by swallowing numerous capsules filled with the proper proportions of proteins, carbohydrates and fats, together with the right amount of vitamins, minerals, and trace elements. For such a regimen, teeth would not be necessary. Teeth are needed to masticate the food properly and get it thoroughly ensalivated. Perhaps nature planned to reduce the masticatory stress of elderly people so it would take them longer to eat and spend more time at the table. It is said that the best dentures are only one-fifth as efficient as the patient's teeth were when the natural dentition was in good condition in the younger years.

A LOOK TO THE FUTURE

The day is not far distant when dentistry will be regarded universally as a health service; the dentist will be looked upon as the mouth physician; and every oral prosthesis will be considered to be a therapeutic device rather than a mechanical thing.

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SECTION C/ASPECTS SPECIAL TO THE ALLIED HEALTH PROFESSIONS

Part XVII/Nursing

NURSING OF THE AGING AND AGED

By

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CURRENT STATUS OF GERIATRIC NURSING IN UNITED STATES

Nursing of the elderly was early developed as a family art in the United States. This is evidenced by the adult cradles and invalid feeding cups among historical collections of colonial household furnishings. Only within the last 20 years, however, has geriatric nursing emerged as a developing professional service in our society. The recency of this phenomenon is substantiated by a sparsity of publications on the subject in English language nursing journals as late as 1950 (Basson, 1967; Brown et al., 1967).

Prior to the midcentury, registered nurses applied general principles of nursing to the aged, adapting their care to the needs of individuals. Some nurses further developed the art of nursing the aged by creating procedures aimed at providing comfort and safety and at preventing and controlling frequent problems, such as decubitus ulcers, hypostatic pneumonia, postural contractures and nutritional anemias (Newton and Anderson, 1966). In the last 10 years, the pace of development of the art of geriatric nursing has been accelerated. Many more nurses have had opportunity to concentrate on the elderly and their nursing needs in home care programs, visiting nurse services, extended care facilities and day care centers (Miller et al., 1966; U.S. Dept. HEW, 1967–a; 1968). Additional resources, improved facilities and increased public and professional interest in older people and their care have made this possible.

The art of geriatric nursing is now being undergirded with a scientific base of knowledge and implemented by a growing number of nurses informed and skilled in many aspects of nursing of the aged (Knowles, 1965). The small but growing body of research (Lambertsen, 1968; Brown, 1969; Exton-Smith et al., 1962) concerned specifically with geriatric nursing includes such diverse areas as retraining of elderly incontinent patients (Adams et al., 1966), socialization of the long-term institutionalized aged (Silver et al., 1963; Weiss, 1968), and care of the dying (Quint, 1966). Some of the research focuses on the direct care needed by individuals (Schwartz et al., 1964). Other research seeks to describe nursing needs of aggregates of older persons (Exton-Smith et al., 1962; Kelleber and Shaughnessy, 1964; Norton, 1967; U.S. Dept. HEW, 1967–b).

As nursing is a practice discipline based upon knowledge from many basic and applied sciences, the recent emergence of gerontology has proved a great impetus to the development of nursing of the aged. Insights relative to the processes of aging among persons in our society provide nurses with a basis for understanding physical and behavioral changes. With this increased understanding, nurses are able to support healthful living practices among the aging and more readily identify symptoms and signs of incipient disease. Interpretations by nurses enable elderly patients and their families to better utilize medical, social and personal resources in planning for more healthful and satisfying living in the late years.

The nursing of aged persons whose health state is closer to the well end of Dunn's (1967) continuum of health has added a new dimension to modern-day nursing. Nursing that maintains and augments this healthy life among persons who are experiencing primarily aging changes, as opposed to disease processes, is commonly known in this country as gerontological nursing. Gerontologic nursing places emphasis on the scientific base of knowledge from gerontology and on the health promotional aspects of nursing. In contrast,

geriatric nursing is more frequently concerned with the care of the sick, infirm and disabled whose health states are greatly influenced by pathological processes. Nevertheless, even in the nurturing, supporting, and maintenance care that constitutes much of the nursing of the most dependent aged ill, an element of promotion of healthy aspects of life is preserved. The separation of nursing of the aged into gerontologic and geriatric nursing is not proposed. Rather, the two terms are herein used to differentiate their emphases.

Drawing upon various bodies of knowledge, nursing educators are providing increasing opportunities for students of nursing to learn both gerontological and geriatric nursing (Lane, 1964). Teachers of practical nursing programs may be credited with first introducing any appreciable amount of geriatric nursing into their nursing curriculums. It was recognized that licensed practical nurses would be employed in large numbers to care for the aged ill in nursing homes, in their own homes and more recently in extended care facilities. Consequently, clinical experience in institutions for the aged was often provided to students of practical nursing from the late forties. Drawing heavily on the empirically learned art of geriatric nursing, didactic material augmented clinical practice (Stevens, 1965).

On the other hand, programs in both collegiate and hospital schools preparing students for registered nurse practice have had little content in geriatric nursing until very recently. A recent study of collegiate nursing programs in California by Moses and Lake (1968) showed little evidence of teaching relative to the aged. Similarly, students in hospital diploma programs have had little emphasis on nursing adapted to the needs of the aged. The reluctance of physicians to develop geriatrics as a specialty, coupled with hospital policies (Moses, 1967), and economics favoring early discharge of the aged, infirm and chronically ill have tended to discourage the emergence of strong geriatric nursing studies in most hospital-based nursing programs.

The recent development of educational programs in gerontologic and geriatric nursing at the masters level of study in several universities holds great promise. Though the numbers of students completing these post-baccalaureate programs is small, the graduates, through research and specialized practice, should develop a broader scientific base for nursing the aged and demonstrate quality care to students and staff. Already, specially prepared faculty and young graduates of these programs are augmenting the content of many programs of continuing education which are offered to nurses working with the aged in a wide variety of service agencies. Such supplementary geriatric educational programs for nurse practitioners are currently being supported by both voluntary and governmental health agencies and professional nursing organizations.

Improvement in geriatric nursing practice is also being actively promoted by the American Nurses' Association (Davis, 1968). This professional nursing organization has publicly supported legislation that provides for health care to the aged. In 1958 it supported the extension of the social security system to include health insurance coverage for the aged. Policies for nursing practice in nursing homes were published in 1960 by the American Nurses' Association to set standards of care. In 1962 a Conference Group on Geriatric Nursing Practice was initiated within this nursing organization. One of the 5 original Divisions of Practice established in 1966 was in geriatric nursing. A standards committee of this division has been working since May 1968, to develop standards of geriatric nursing practice by which practitioners of geriatric nursing may judge the quality of the care that they and their coworkers are providing the aged.

The American Nurses' Association is also engaged in the development of a program of certification which will recognize geriatric nursing practitioners of superior performance. Certification will be based on criteria that include both a sound knowledge of the aging process and geriatric nursing and competence of practice based on this knowledge. Conference groups of nurses within the Division of Geriatric Nursing Practice are functioning at the national level and in many States to assist one another in solving problems of providing nursing care to the growing numbers of aged persons.

Thus, it may be anticipated that this recently developed area of nursing practice, geriatric nursing, will grow in stature and availability. The base of knowledge from both nursing and related sciences is increasing. More nursing educational programs at all levels, from those for students of practical nursing to those offering post-baccalaureate specialization, are including some preparation in nursing of the aged. Quality of practice in this field is of concern to the profession of nursing and is being upgraded by continuing education, setting of standards and recognition of excellence of performance by certification.

EVOLVING NATURE OF PROFESSIONAL GERIATRIC NURSING

As noted above, nurses adapted the family art of caring for the aged and augmented it as they undertook the daily care of increasing numbers of sick and infirm elderly in their homes, general hospitals, nursing homes and psychiatric hospitals. At first, their objectives remained that of the family art: (1) to keep the aged patient fed, quiet, safe, clean and free from pain; and (2) to follow the doctor's orders. As new knowledge was applied, the goals and nature of geriatric nursing began to evolve from this family art to a broader service in which the registered nurse took initiative and responsibility in defining and meeting patients' health and nursing needs.

The Inadequacy of the Family Art of Nursing

It was recognized that nursing as an art, together with inadequate medical care, had resulted in great numbers of incapacitated, withdrawn, institutionalized aged persons who were dependent on large amounts of personal care in settings expensive to society. Too often the states of health and well-being of these persons were deplorable and repulsive to the patients themselves, families, society as a whole and to the health professions. Unfortunately, these dependent, aged ill were largely inconspicuous until the great numbers were felt through the growing tax burden and the shortages of beds in psychiatric and general hospitals. The recent rejection and neglect of the institutionalized dependent aged by all groups is well documented (Brown, 1969). Today, society, the nursing profession and the medical profession challenge such care.

Unfortunately, there are still many aged persons whose nursing care is limited to this custodial and technical level. They can be found in nursing homes of all levels of cost. Some factors that seem to perpetuate this kind of nursing include: (1) the conduct of institutional nursing services without the control and guidance of a well-prepared professional nurse; (2) the misconception of patients, families and many health professionals that personal service is synonymous with good nursing care; and (3) the restricted numbers of nurses prepared in the specialty of geriatric nursing.

Definition of Geriatric Nursing

The fundamental definition of nursing, enunciated by Harmer and Henderson (1955), reveals the limitations and fallacies of such nursing.

> "Nursing is primarily assisting the individual (sick or well) in the performance of those activities contributing to health, or its recovery (or to a peaceful death) that he would perform unaided if he had the necessary strength, will or knowledge. It is likewise the unique contribution of nursing to help the individual to be independent of such assistance as soon as possible."

Geriatric nursing is an interactional process carried on between the aging patient and a nurse by which the patient is assisted in solving problems of health, personal care and disability due to aging and related pathology. These problems may be ones of immediacy, such as insomnia and pain, or long-time problems such as coping with the stresses of a terminal malignancy. This nursing process is carried on in concert with the persons who make up the nursing team, the medical care team, the family circle and other caring groups (Reese, 1968). Like any problem-solving process, it follows the several steps of: (1) the examination of all evidence to identify a soluble problem of high priority; (2) the collection of information about resources available for possible solutions; (3) the design of a possible course of action to reach a solution; (4) the conduct of that course of action; and (5) the evaluation of effectiveness. The last step may serve to identify another problem or reveal that another course of action needs to be tried to solve the original one. Throughout the process, the nurse and patient together assess each step and act jointly to the extent the patient is capable of participating.

This process is the same with a patient of any age. Geriatric nursing takes its uniqueness from: the stage of life of the individual; the nature of disease and disability common to the aged group; the physiologic, sociologic and psychologic changes that have occurred because of the aging process; and the increasing probability of death (Rodstein, 1964; Shaughnessy, 1964).

Changing Goals of Geriatric Nursing

With this fuller definition of nursing, the goals of the traditional art of nursing of the aged are expanded and modified.

The objective of seeing that the patient is fed enlarges to include such nursing (Piper and Smith, 1964), as: (1) securing a nutritious diet that is compatible with the patient's health state and life habits and that will promote health and control disease; (2) assisting the patient to eat and enjoy his food; (3) helping the patient to understand his nutritional

needs; (4) interpreting the patient's unique needs and food preferences to a dietitian or home helper; (5) maintaining cleanliness and health of mouth to facilitate eating; and (6) planning with the doctor regarding therapeutic diet needs or problems.

The goal of keeping the patient quiet (and inconspicuous) is valid only if quietness is a sign of peace, needed rest or social consideration for others. More often than seeking quiet, it is now the geriatric nurse's goal to assist the aged patient to use any effective means of communication that will increase his social involvement, enable him to reach solutions to his problems and express his own experiencing of life (Ruesch, 1961). More will be said later of the socializing nature of geriatric nursing.

The objective of safety for the aged patient is fraught with paradoxes and dilemmas. The feeble aged person may be protected from falling by fastening him in a wheelchair. But from whence should come inability to walk? From a potential fall and fracture or from restraint in a chair with concomitant and personality atrophy and contractures? Whose safety is at stake? Is restraint to protect the patient, or the institution and personnel from suit for neglect? Such dilemmas should be worked out jointly by all concerned, including the patient. If a creative problem-solving approach is taken, better ways of maintaining mobility in the very aged and infirm can be found (Schwartz et al., 1963).

The goal of cleanliness requires understanding and a sense of humor on the part of all. The excessive concern with cleanliness that established hospital patterns of a daily bath may be as deleterious to the aged patient as neglect of skin and personal hygiene. The usual life habits of bathing of most older persons require only slight changes to keep the individual socially acceptable, protect the skin from excessive drying or irritation and permit surveillance of the body for signs of pathology. These changes in life patterns of bathing, slight as they may be, are often accompanied by feelings of dependency and invasion of privacy on the part of the patient and conflict with a procedurally-oriented nursing person. These adaptations can be worked out in almost every situation to the satisfactions of all, if a joint problem-solving approach is taken with full respect for the elderly individual. On the constructive side, cleanliness and attractiveness are often values of older people which can be tapped to stimulate their self-respect and sense of social worth.

Two aspects of body cleanliness that constitute special nursing problems are oral care and incontinence of bowel and bladder. Fortunately, there are many commercial aides to denture care and oral cleanliness. If these are consistently used along with periodic care by dentist and dental hygienist, older persons can enjoy functional dentures and healthy, clean, comfortable mouths. Nursing personnel will experience a lessening of the unpleasantness of this nursing task.

Much study has been applied to the problems of care of patients who are incontinent or involuntary of bowel and bladder (Adams et al., 1966; Saxon, 1962). The great value of intensive preventive care during acute illness, the establishment of habit training, and medical and surgical treatment of pathology have been well demonstrated. Failure to maintain socially accepted ways of toileting are a frequent concomitant of desocialization of the recluse and neglected institutionalized persons. The successful treatment of the basic problem of total neglect is often first evidenced by gain in toileting behavior. Though various techniques and devices for keeping incontinent patients dry and clean have been developed, they should be used only as accessories to care. The basic problem underlying the soiling behavior should be sought out and treated jointly by nurse, doctor, family and patient. It is the latter who must regain bladder and bowel control and maintain it.

The family art of geriatric nursing depended heavily upon analgesic drugs and positioning to relieve pain. There is much more knowledge today that permits prevention of pain. A regular regimen of exercise and rest established early in life and the selective use of physical therapy promote improved circulation, joint mobility and muscle tone. Far more medical knowledge from rheumatologists and endocrinologists should be utilized to prevent and counteract the many annoying aches and pains of the aging.

As pain is often a symptom of pathology, much more attention is now being paid to it in the aged. Too often in the past, mild analgesics were used indiscriminately rather than determining what basic condition needed to be changed. Pain and discomfort from pressure, poor posture and inactivity are alarms that permit the prevention of decubiti, contractures of joints, deterioration of muscles and the accompanying disability.

More humane treatment of intractable pain by the use of regular administration of analgesics has demonstrated the value of preventing recurring pain. If the pain-ridden individual is assured that he will not be

permitted to suffer from pain, he loses his anxiety. Having faith that the nursing-medical team will prevent the recurrence of pain, he is much more able to live through long periods of severe pathology before a peaceful death occurs. Cecily Saunders (1965), herself a physician and a nurse, promotes this approach to recurrent pain. It merits more application and study.

Team Health Care of the Aged

The final dictum in the family art of nursing of the aged has been to follow the doctor's orders. Such a rule loses relevance when patient care is jointly developed by a team of health professionals together with the patient and the family (Reese, 1968). The ideas of each discipline are utilized in the plan of therapeutic care and its implementation. Each is recognized to bring his special knowledge and expertise to bear on the problem.

The patient provides his point of view, a fuller knowledge of himself and his pattern of life, and empirical observations of what seems to work in relation to his disease and symptoms. The family brings to the planning and decision-making their resources and their own limitations and needs. Without his family, the aged individual is stripped of his family role relations and the affective love and challenging expectations of its members. The physician's knowledge of medical science and the art and skills of diagnosis and therapy are essential whether the older person is suffering from the pathology of a disease syndrome or the disability of an aging body. To such problem solving, the nurse brings the art and knowledge of nursing care, her interpersonal and social skills of coordination, and assistance in developing and carrying out the plan of therapy and healthful living. Any member of the team may initiate the inclusion of other health professionals or community services to supplement the basic team of patient, family, doctor and nurse.

Movement from the dyad of patient and doctor, or the triad of patient, doctor and nurse, to a multidisciplinary team is a reflection of the change in social organization in our society. Just as the business tycoon has been replaced by a complex system utilizing a great variety of "organization men," so health care has come to be a team service staffed by a variety of disciplines. The various health disciplines must work together on the behalf of the geron if his integrity is to be maintained, his health potential maximized, and excessive waste of resources to be avoided.

With particular patients, the functions performed by any one discipline are determined by many factors, such as specific competencies of the various persons, the availability and mix of health disciplines and the ability of the patient to use some individuals. The interplay of these factors may be illustrated by several examples.

If an older person has known only physicians in the care of his health, it may be necessary for the doctor to tell him that he should eat liver. By doing so he accords the authority of a "doctor's order." The nutritionist and/or dietitian may be far more competent in explaining why, and working out ways by which liver may be prepared and served in ways acceptable to the patient.

The age of a particular member of a health team may influence his use by a particular patient. Extreme youth may be a basis for a geron's rejecting the counsel of any health worker. Though studies suggest that the aged tend to shift from their peer group to the middle aged for advice, the particular preference of any aged person may vary from this. Sex is another variable that may affect the working relations of an elderly person with the team.

Less apparent is the subtle influence of attitudes, such as feelings about independence-dependence. Each health worker brings his own expectations, preferences and goals for a patient's level of independence. Real effort should be made by all members of the team to come to a common agreement on reasonable expectations with a particular patient. For the determined stroke patient, the rehabilitation-oriented physical therapist may be the best channel through which a team works with him. For the very dependent patient with little potential of improvement, the nurse may be the logical organizer and decision-maker in his care.

More than cooperation is needed among the health disciplines caring for the aged. Joint planning, acceptance of common goals and complementary action to support the work of each other is needed as well as supplementary services. If an occupational therapist is helping a patient to regain function through progressive practice in activities of daily living, the other health team members support this service. The nurse helps the patient put to practice new skills and functions in his daily life. The physician helps keep the patient under the care of the occupational therapist until optimum gains have been made. The social worker works with patient, family and community resources for residential living that will enable the pa-

tient to retain and increase the progress made with the help of the occupational therapist.

Nursing as a service is also rendered by a team. The determination of long-term need and a changing plan for nursing should be made by the most able nurse available, certainly, the registered nurse. Practical nurses, short-term trained aides and home-help aides should carry on their work with the guidance, teaching and supervision of the registered nurse who is legally responsible for the nursing care. Lacking special preparation in geriatric nursing, the registered nurse should have available, and utilize maximally, the geriatric nursing specialist. Agencies providing nursing care to the aged at home, in nursing homes and in extended-care facilities should make every effort to secure such specialists either as members of their staffs or through consultation services on a regular basis. The need is equally as great in hospitals, but will probably be met more slowly because of the low-priority value placed in hospitals on needs of aged patients.

The well-prepared geriatric nurse recognizes patients' priorities and adjusts responsibilities and functions accordingly. An example is offered to illustrate this principle. Because of fee changes, a series of transfers of patients to different rooms and from single to double rooms was ordered one afternoon by the administrator of a nursing home. The only registered nurse on duty on the 3 to 11 shift customarily administered the medications and carried out treatments. This sudden shifting of patients was a new experience to her and she thoughtlessly started the usual procedure of preparing the medicines for administration. By five o'clock, the aides and practical nurses, who had started to make the transfers, began to report the extremely disturbed state of the patients. Such disturbances might have been anticipated in the presence of precipitous moving of the aged. The nurse stopped all further transfers for the day and concentrated on orienting, reassuring and helping the patients to adjust to the changes that had already occurred. Further, she enabled staff to attend patients who preferred them and to give their patients the needed attention and assistance in "settling" into their new quarters. Her support and help to the staff, in turn, enabled them to support and help their patients. Medicines were late and unessential ones were omitted that busy evening. Further, the registered nurse reported the situation and sought a wiser policy regarding transfer of patients. Unfortunately, her requests were not heeded. The regular services of a geriatric nurse might have enabled the nursing staff to secure a better policy and procedure either before or after this episode.

The team functioning of this group of nursing personnel grew through this event. The lack of team action by administrator and nurses was obvious. Inadequate medical involvement was also evidenced. The lack of fundamental geriatric nursing knowledge resulted in very poor patient care that was hardly rectified that evening. The impact was more long-range than that one shift.

Thus professional geriatric nursing is gradually developing from the application of arts and skills in the direct personal care of aged patients to the expanded responsibility and function of coordinate planning of care, provision of care by the nurse herself or through licensed practical nurses and aides taught and guided by her, and the constant evaluation and adjustment of plans to meet the changing needs of patients (Reiter, 1964). Judgment and decision making are based on broad knowledge of related sciences as well as of the skills of nursing care, communication, group dynamics, problem solving and evaluation. A few selected areas of knowledge that the nurse uses in geriatric professional practice are presented in the following section.

APPLICATION OF KNOWLEDGE TO NURSING OF THE AGED

In the practice of geriatric nursing the professional nurse utilizes knowledge and theories from as diverse fields as gerontology, sociology, psychology, medical science and physiology. It will be noted from the examples presented that geriatric nurses are primarily concerned with individualized nursing problems of aging and aged persons, as opposed to focusing on organic pathology, disease syndromes and medical therapy. These latter are seen as the area of expertise of the physicians. The nursing problems arise from symptoms of aging and disease that override any one disease entity, such as immobility, dependency, loss of social roles, confusion and other behavioral changes. Therefore, the kinds of knowledge and theories that are of most help to the nurse are drawn from the behavioral sciences. Three examples of application of scientific theories and knowledge are presented: (1) using developmental theories of aging, (2) the geriatric nurse as a socializing agent; and (3) nursing the confused.

Using Developmental Theories of Aging

Scientists with frames of reference as different as sociology, psychology, sociopsychology, biology and genetic theory have proposed various conceptual formulations that describe the most commonly recurring behavioral phenomena associated with aging. As these various theories are supported by only limited research and are often controversial, a nurse can apply them only tentatively as she seeks to understand the changing behavior of an aging individual. In spite of their tentativeness, such theories provide ways of looking at a nursing problem and suggest goals and methods to use in solving the problem.

Nurses who work with residents in homes for the aged are frequently confronted with persons who are sharply reducing their contacts with other persons, or who spend increasing amounts of time alone, reading and dozing. At the same time there may be a decline in personal habits of cleanliness and dress. Conversations become infrequent and verbal exchange is less courteous, stimulating and current.

Because of the biological orientation of medicine, the alert nurse seeks signs of physiologic deterioration that may be the base of such changed sociopsychologic behavior. Are there signs of malnutrition—loss of weight, anemia and reduced muscle tone? Is loss of hearing or vision interfering with communication? Are there symptoms of physical pathology—shortness of breath, pain, change in gait, cyanosis, loss of appetite? Ruling out a physical base together with the physician, the nurse turns to psychosocial theory to understand this behavior.

She may consider the social theory of aging proposed by Cumming and Henry (1961):

> Aging is an inevitable mutual withdrawal or disengagement, resulting in decreased interaction between the aging person and others in the social systems he belongs to. The process may be initiated by the individual or by others in the situation * * *. His withdrawal may be accompanied from the outset by an increased preoccupation with himself. * * *

This process is distinguished by: (a) change in the number of persons with whom the aged interact; (b) qualitative changes in the styles or patterns of interaction; and (c) personality changes that both cause and result in decreased involvement with others and increased preoccupation with self.

Accepting this theory as a tentative base for approaching the problem, the nurse questions whether other persons have initiated a withdrawal. Have relatives and friends reduced their visits, telephone calls, letters and invitations to go out of the home? Has a close friend among the residents left the home, died, or been placed in the infirmary? Has there been a change of personnel or program that has reduced the friendly social and recreational life of this withdrawing aged resident?

Even while using the Cumming and Henry theory, the nurse is aware of the criticism of it—particularly the alleged universality of the pattern. She recognizes that she herself tends to accept an activist theory for the aged. As she works on behalf of a society, an institution, and a medical group that all espouse the social values of independence, activity and productivity, she considers the usefulness of these values in setting goals with this increasingly less-involved older person.

The integrity of the ego of the older person, proposed by Erickson (1963) as the final developmental goal of old age, may be a more appropriate and feasible aim in life for a particular resident, family, doctor and nurse. If the aged one can be assisted to accept his life as it has been, and promises to be, in such a way that he avoids despair and gains a sense of self-fulfillment, health care may be deemed successful in some cases, irrespective of a decrease in social involvement.

The Geriatric Nurse as a Socializing Agent

The nurse faces the reality of society's expectations and helps each aged person to face and accept those ways of behaving that will permit him to remain a socialized and functioning human being. By positive reinforcement and personal assistance, she supports behavior of cleanliness, appropriate dress and pleasant, courteous social interaction. By planned attention, approval and standard-setting, she uses herself as a socializing agent.

The socializing role of the nurse is demonstrated most clearly in the rehabilitation of aged persons who have been depersonalized and desocialized by prolonged institutionalized custody. Like a mother socializing her toddler, the nurse may be heard to praise, "You've stayed dry all day; that's fine," and "Ah, that dress looks so pretty on you." Or she may guide and direct, "After you have finished dressing, go to the bathroom and Mr. Smith (aide) will help you shave." At times she sets standards, "Zip up your zipper." "The residents here take off their night clothes, and dress

each morning." Though some nursing practitioners unconsciously interact in this socializing manner, the professional geriatric nurse consciously and selectively uses herself as a meaningful alterant to strengthen the person's sense of worth and reinforce behavior that makes him acceptable and welcomed by his immediate social group and the larger society.

The socializing goals held for any older person are adapted in terms of his state of health and level of functioning. Placing an individual in a wheelchair in a busy doorway where institutional personnel and residents are obliged to regularly see and interact may be appropriate for the very dependent, nonverbal, depersonalized individual. At a different level of need is the retired aged pharmacist with whom the nurse works to locate a part-time volunteer or paying position in a local pharmacy. In either case, the nurse is enlarging the life space of the individual so that he is obliged to intereact as a social being with more people who recognize him as a significant person. As he acquires more roles in social groups, he becomes more fully socialized.

Far more difficult is the socializing role of the professional nurse on the ward of a chronic disease hospital where a physically-dependent paralytic has acquired a pattern of securing the attention of staff by constant complaint, insult and profanity. Other patients and staff alike have rejected this individual. Needed physical care is given reluctantly, with hostility and only because of a sense of ethical responsibility. Only by careful exploration of the staff and the patient of the destructive relationships and interaction, followed by a nursing plan that supports and fosters constructive interaction can the nurse hope to bring about favorable change. In the course of working through one or more of these problematic social situations, the staff gains insight and understanding of their own and the patient's feelings and psychological mechanisms. They gain skill in the conscious use of self in the social and psychological, as well as physical aspects of nursing. Fortunate is the nurse who has the assistance of a social psychologist in working through such problems with aged patients, families and nursing and medical personnel.

Nursing the Confused

Confusion, disorientation and marked loss of memory are frequently the presenting symptoms that precipitate a search for medical and nursing care by patient and family. These symptoms may develop gradually over weeks and months, occur suddenly as at the onset of pneumonia or a covert cerebral accident, or develop in two or three days following a sudden change of environment, such as a move from home to institutional life. In no condition is closer cooperation needed among doctor, family and nurse. Such behavoral changes are shame-laden and fear-inducing to the patient, family and close ones. What holds greater fear for the aged than "losing one's mind?" The physician is faced with a difficult diagnostic problem. He values the nurses' observations of relevant signs and symptoms. The frequency of irresolution of diagnosis is evidenced by the indiscriminate use of diagnoses of senility and chronic brain syndrome (Somers and Bentley, 1961). The nursing problems are equally difficult and often frustrating. All must work closely in a coordinated plan of therapy and care, and often over a very long period of time, to insure the individual his maximum return and maintenance of functioning.

Careful observation on the part of the nurse permits a better understanding of the periodicity and content of disoriented episodes. Further, she may note environmental situations and events that are correlates of confusion and clarity. One person may be benefited by visitors, roommates, regular television programs and involvement in social groups. Others may not be able to integrate such experiences into a fragile orientation without confusion. Some nursing or institutional programs and activities may be beneficial, or they may be the reverse. Regular and familiar habits of rest, eating, exercise and activities should be reestablished if possible, and response noted.

Special attention is given to behavior associated with the administration of medications. Because of individualized reaction of persons to complex chemicals, many seemingly innocuous drugs may increase confusion and agitation. Cumulative effects of otherwise safe drugs should be considered as a factor in periodic episodes of confusion. Nursing measures that induce sleep and regular bowel habits should replace medications, especially during a diagnostic period. Newly prescribed drugs should be accompanied with careful observations for change in behavior, both expected and unexpected in nature.

Establishment of communication with the confused, disoriented aged patient is essential (Ruesch and Bateson, 1951). The use of communication as therapy is a skill gained by the professional nurse in the study of psychiatric patients (Davis, 1963).

Much can be communicated about the interest,

concern and caring on the part of the nurse for the patient by touch. Slow, firm but gentle contact can reassure the aged of the sustaining force of the nurse. Touch is especially needed to secure the attention of the aged person with reduced hearing or sight (Johnson, 1965). The nurse's ability to utilize touch in communication has been refined in the nursing of children, maternity patients and persons of other cultures for whom touch holds different meanings.

In seeking meaningful subjects of conversation, the nurse recognizes the frequent rich recall of the past among the aged (Sink, 1966). Often previous events and experiences hold more value and meaning for the aged person than the present. Recalling and reviewing satisfying life roles and relationships may provide the first intelligent prolonged communication with a confused or disoriented geron. Knowledge of these valued former aspects of life enables the nurse to introduce current experiences that can be associated with the customary patterns of life (Williams and Wirths, 1965). The more frequently that the aged person's orientation and reality-based communication can be validated and rewarded, the greater his satisfactions in his current relationships and the more solid is his sense of integration of his experiences.

All nursing personnel assist the individual to secure and maintain an orientation in time and space. They reinforce the orientation of the individual by providing frequent regular verbal and nonverbal signals of time, location and an orderly pattern of living. Clocks, calendars, verbal announcements, daily newspapers and a regular time for meals, bathing, sleep and other events of living reinforce orientation to time. Signs, labels, name pins, distinctive decorations and furnishings, supported by verbal repetition, assist in spatial orientation. Of great importance is the identification of the room or living space, furniture and belongings of that individual. His property rights should be inviolate. Often maintenance of such reinforcements enables the badly damaged aged one to maintain a sense of reality and orderly orientation. Without it, confusion, anxiety, fear and problems of wandering, taking the belongings of others, and disruption of bowel and bladder habits are increased.

Thus the professional nurse draws from gerontology, communication theory, group dynamics, social anthropology, pathophysiology, psychology, pharmacology, geriatrics and nursing knowledge to nurse the confused and disoriented older person.

These three illustrations serve only to describe the breadth of knowledge that the professional geriatric nurse can bring to the care of the aged. In the first nursing problem, the nurse seeks a theory of aging that serves to illustrate a change in behavior and to develop jointly a goal of living that is acceptable to the patient and feasible of attainment.

The second illustration serves to describe the variability of conscious socializing behavior that the professional nurse demonstrates as she adapts to the specific needs of individual patients. The use of self as a socializing agent is a self-directed nursing therapy that can only be employed when the social functioning of the geron is included in the nursing assessment and goal of care.

The nursing of the confused serves to illustrate the diversity of knowledge that the professional nurse must utilize in working with a number of patients whose confusion may have arisen in relation to a number of physical and experiential correlates. Though the medical diagnosis and therapy will guide her in some cases, most of her nursing is aimed at understanding and reducing the confusion as a symptom.

Thus, it may be seen that the family art of nursing the aged is changed by the professional nurse. Her knowledge of the underlying behavioral, natural and applied sciences enables her to approach the nursing needs of the elderly with a much greater repertoire of possible solutions than were provided by the simple skills of personal care and techniques of nursing.

SUMMARY

Though this presentation is only suggestive of the nature of geriatric nursing as it is evolving from the honorable family art, it is hoped that it serves to illustrate the potential contribution that geriatric nurses can make in the nursing of the aged. Professional geriatric nurses can only hope to meet the needs of the aged ill if they are complemented by large numbers of nursing personnel who are interested in the aged and skilled in personal care and nursing techniques, who have learned to work together as a team. Such nursing, in harmony with physicians, families and others, enables each aged person to do that which he could not do alone. Thus he experiences a higher level of well-being, functioning and satisfaction in living.

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SECTION C/ASPECTS SPECIAL TO THE ALLIED HEALTH PROFESSIONS

Part XVIII/Occupational Therapy

THE ROLE OF OCCUPATIONAL THERAPY IN HEALTH CARE OF THE AGED

By

Florence S. Cromwell, M.A., O.T.R.

There is no evidence to suggest that life satisfactions of older people are any different than those of younger people. Similarly, needs of sick persons at any age can be identified by well-established professional techniques and then be dealt with. Thus, the skills for meeting needs of the ill, aged person can be delineated and acquired by established professional entities. In speaking of ongoing health needs of the aged, one is on much less firm ground. The time-related changes in the body of the aging human are variable and not subject to generalized prediction. However, since most aged persons—and there are now estimated to be 19 million over age 65—are essentially not ill and are able to function in semi-to-full independence, there exists a large capability for prevention of debilitation in this age group.

Occupational therapy is the art and science of directing man's response to selected activity, to promote and maintain health, to prevent disability, to evaluate behavior, and to treat or train patients with physical or psychosocial dysfunction. (American Occupational Therapy Association, 1969). Essentially this definition is based on our belief that man through the use of his hands, as they are energized by mind and will, can influence the state of his own health (Reilly, 1962). In these statements rests the basic premise for the need and value of occupational therapy for the aged. In the pages to follow, the relationships of activity to human function and the distinct contributions of occupational therapy to man's health will be examined. Also suggestions will be made to guide those interested in and responsible for meeting the health needs of the aged population in effectively working with the occupational therapist.

ACTIVITY AND THE AGING PROCESS

Aging is an individual process. Prediction, at this stage of man's understanding of aging, is still more guess than fact. People of like chronological ages and even similar circumstances vary greatly in physiological age. Thus, the kinds of needs each may have for independence and for self-resolution of his own needs follow no predictable pattern. One thing is certain—in aging, one's individual life style continues. Thus, one's needs are intimately intertwined with the patterns of living, thinking, working and loving that one has acquired through his years. And the way in which any human finds satisfaction and sustenance is uniquely his own, regardless of age. Society has not yet acquired respect for this concept—especially for the aging person. We still are prone to generalize—people should retire at a given age, automatically assume certain helpless qualities, need to be grouped for "retirement fun," and inevitably become irretrievably enfeebled. All too often, just being old automatically obscures the individual's innate capabilities, needs and desires and, most unfortunately, general confidence in him as a mature self-determining person.

Paradoxically, society places high emphasis on creativity for all, at least as embodied in the "do-it-yourself" industry, and also on active leisure as seen in the exploding recreational enterprises in the country. Pre-retired and retired citizens are prime targets for each of these industry segments and indeed have also been prime consumers—but not all happily so.

Occupational therapy, with its theories based on activity as it related to man's individual needs, offers unusual potential for understanding and meeting the needs of aging people, ill or well. The occupational

therapist, as a developmental specialist, can bring much to the efforts of either "sick-care" or "well-care" teams in identifying human needs and programming for them.

ACTIVITY: ITS RELATIONSHIP WITH LIVING

Much has been written and extensive and comprehensive research and study have been done on *thinking* and *feeling* as they relate to man's function, his needs, his behavior. Yet the third aspect of the trilogy of man's existence—*doing*—we have only begun to explore. We know too little about motor performance, about task orientation and tasks of the family, about what activities of all kinds contribute to or detract from man's well-being and why, of what are the social and cultural, as well as physiological and psychological determinants of ones' pattern of choice, of one's modes of performance, of the activities that comprise our lives and indeed, of living itself.

Activity, doing, is essential to life and is so intimately entwined with thinking and feeling that in its absence those two aspects of function are distorted. The key to man's continued and integrated existence is activity, meaningful to him. In programs for the aged and in society's attitudes toward the aged, effort, conscious or otherwise, has been directed toward reducing activity, restricting need for it, introducing more care by others, anticipating less ability to be active, indeed penalizing those whose interest and abilities seek continued involvement through work. The occupational therapist believes in and uses activity of all kinds, adapted to the individual's life style, to his role needs as well as to his physical and psychological capabilities. Writers have said the greatest fears of the older person are loss of independence and security. Both are undeniably tied to ability to be active, to care for oneself, to retain capability for doing.

In another way one might say the greatest threats to the aging person are *helplessness* and *hopelessness*. The medical field has traditionally dealt with more tangible pathology in both the physiological and psychological realms. Internists can cope with arteriosclerosis and arthritis; psychiatrists can confront depression, paranoia, anger; but almost no direct study has been done on the meaning of hope to man, or what the destruction of hope does to all other therapeutic efforts. Writings are only now emerging on this subject (Fromm, 1968; Murany, 1961).

NEEDS VERSUS LIFE ROLES

One might say that the most stable underpinnings for hope and independence are the ties with the familiar, and with the behaviors which are basic fabric of one's security. In the aged, this means the retention of the patterns of successful adaptation of the middle years, the commitments which have been the important keystones to life adjustment as one moved from work toward retirement, the choices one made as his scope of function changed. Some studies (McCoy, 1959; Walker, 1959; Waggoner, 1968) have identified the satisfactions which the aged find in present environments. These showed inevitable ties with prior behaviors. Others have devised tools to measure the state of adaptation in the middle years, around the activities of work, play and family (Wong, 1969–a; 1969–b). All these give valuable clues to the occupational therapist in assessing the aged person's present role needs. Those viewed against the backdrop of present physical and psychological states produce the ingredients for designing the environment in which the person can best function.

THE OCCUPATIONAL THERAPIST

The occupational therapist becomes that environment specialist, translating at a simple primitive level the patient's role needs into an activity process and living setting where adaptation can be nurtured and disintegration minimized. Only when those dealing with the aging person come to accept this social adaptation process as the basis to all therapeutic programming will the inexorable deterioration of the able elderly be halted. Simple adjustments in setting, in schedule, in overall regimen geared to each person's needs frequently can create the atmosphere for integration rather than disintegration. Additionally, more flexible staff and family attitudes which allow individual decision making, expression and behavior are essential. But the key to success rather than chaos in full blown individualization of the environment is careful identity of basic needs, an understanding of role strivings by each aged person, and carefully tailored changes in milieu to foster optimum function. The occupational therapist can, through her efforts and understanding, provide that key.

Her individual assessment of patient needs, her consultations with staff and families to help create nurturing environments, her specific therapeutic efforts with activities for the aged person to either minimize pathology or retard or prevent disability provide the basis for occupational therapy in geriatrics.

THE OCCUPATIONAL THERAPY PROGRAM

Occupational therapy for the aged has unfortunately been equated with simple busy work, with "time filling" and frequently with superficially-based programs of keeping people "limber, mentally active, and unlonely." While those are common assumptions, they fail to recognize the more profound needs and individualized understandings that characterize effective occupational therapy programming. The seemingly simple cookie baking session for a residential care group may be meeting diverse needs of belonging, of doing for others, for sharing, for phsyical exercise, or for recapitulation of wife roles. The therapist arranges the group and its activity to fulfill the needs of each one in it, based on her understanding of each group member, derived from precise evaluation. Similarly other activities—craft, homemaking, self-care, social, community, interpersonal—are employed by the occupational therapist to meet specific needs. These may include individual or group participation for the purposes of:

(1) Enhancement of healthy integration with one's environment.

(2) Prevention of deterioration by engagement in physical and psychological exercise.

(3) Symptom reduction.

(4) Correction or amelioration of specific pathology.

(5) Limitation of disability.

(6) Provision of opportunity for meaningful participation and problem solving.

PHYSICAL NEEDS

In the area of needs relating to specific physical function and performance, the occupational therapist uses selected activity for any of the following purposes which range from almost static to complex and highly integrative functions: 1) positioning; 2) grading; 3) gross movement; 4) range of motion; 5) strengthening; 6) devicing; 7) precision building; 8) perceptual motor function; 9) activities of daily living. Many media can accommodate these goals in the skillful therapist's hands. All require careful consideration to yield meaningful participation by the target person. Further, any activity employed ideally incorporates fulfillment of the person's psycho-socio-cultural needs, as well as identified physical needs.

PSYCHOSOCIAL NEEDS

While activity for the aged may be seen as primarily related to physical behavior, implying motion or the lack of it, the occupational therapist is equally concerned with activity related to psychological needs. She programs from a broad armamentarium of activity choices and human engagements to meet *thinking* and *feeling* needs. These require *doing* of some kind, individually or in groups, either to relieve specific psychopathology or to prevent deterioration and enhance normal function. Included among the common needs of the aging person which might appropriately respond to occupational therapy programming are loneliness, lack of usefulness, depression, lack of feelings of worth, memory loss, disorientation and paranoia.

Historically, the occupational therapist working with persons with psychopathology has employed therapeutic processes individualized around work or play behavior. From the early humane treatment programs, through emphases on productivity, symptom reduction, attitude therapy, use of self as a treatment agent, group process, reality and responsibility development, the therapist has designed programs of engagement for the individual based on his personalized needs. Most recently, emphasis is coming to bear on specific role reconstruction to align the patient's activity involvement with his role needs, in conjunction with the limitations or demands of his pathology. In so doing, the therapist may well utilize any of the former bases for treatment at given times, but the goal is functional integration based on man's current developmental state. How he got there and the roadblocks now in the way of his maintaining a useful existence form the underpinnings for therapeutic programs to meet psychological needs.

INFLUENCES OF CURRENT LEGISLATION

Because of the provisions in Federal legislation for health services for the elderly, some discussion of occupational therapy in that context would be helpful. There is considerable confusion surrounding the ap-

propriate distinctions to be made by users between physical therapy as it relates to motor function, activity programs as they relate to individual and group recreation and social participation, and occupational therapy.

While physical therapy and occupational therapy are both based on specific health needs and are requested by physicians as part of a total patient-care plan, activity programs are organized things to do with a social, rather than a medical emphasis, to encourage individual and group enterprise and motivation. Physical therapy is basically directed to preservation and restoration of human motion and the therapist generally is called upon to assist with patients who have problems in moving. It is perhaps helpful to think of the physical therapist as the expert in restoring motion and the occupational therapist as the expert who translates whatever ability to move one has into doing the things his role needs demand. Each of these services is based on precise and thorough evaluation and analysis of the patient's present state and on application of specific therapeutic techniques. In general, these two services can be easily distinguished.

More difficulty exists in understanding the differences between occupational therapy and activity programs. Because of the scope of media each service uses and the inevitable similarities and even duplication of choice one observes, the physician and others guiding programs for the aged are urged to examine the rationale behind each service and the orientation to pathology and specific training each worker has.

The occupational therapist's education incorporates careful study of human function, of pathology, as well as of the normal expectations of growth and development throughout life. This specialized understanding of man's needs and function, combined with a broad knowledge of the elements of work and play that characterize normal living, provide the occupational therapist with skills for treating specific pathology, as well as for directing overall activity programs.

The activity director's qualifications are frequently determined by the setting and objectives of the facility, and often represent a specialty in recreation or certain arts and crafts, but not (detailed) understandings of pathology.

Each brings special program dimensions to the needs of aging persons and can enhance the other's efforts. It is not uncommon that the professional occupational therapist (O.T.R.) acts as consultant to the facility's administrative and medical staff on rehabilitation techniques and philosophy to enrich the environment, and to the activity program to exploit its therapeutic value. The technically trained certified occupational therapy assistant (C.O.T.A.) ideally serves as an activity director, bringing to that position both his basic occupational therapy understanding of physical pathology and psychopathology and his special skills and knowledges of therapeutic measures and media. He thus adds breadth to any activity program where some of man's normal needs for doing can be met.

Increasingly, the technically trained occupational therapist, the COTA, is carrying the major load of daily ongoing treatment responsibility in facilities which provide care for the aged person. The OTR provides supervision to this COTA on a regular basis and consultation to the facility's staff and program in general in occupational therapy concepts. While the COTA and OTR provide services of different scope, the individualized programs each provides are built around the same principles described in previous sections of this chapter and may involve the same therapeutic activities. Only the OTR is qualified to provide in-depth evaluation of patient needs and to design broad goals of individual treatment programs to compliment the total patient-care plan. The COTA carries out the day-to-day individual treatment programs and may, in addition, direct and/or consult in the design of Activity Programs in the facility lending therapeutic emphasis to otherwise socially oriented engagements for patients.

Under provisions of the Federal law (Public Law 89–97, 1966) occupational therapists (O.T.R. and C.O.T.A.) give direct patient service on specific written request of the physician and plan individualized treatment programs for identifiable pathology. While not reimbursable as a direct patient service, the O.T.R. may also provide supervision, professional program counsel and guidance to personnel of the facility to enhance the therapeutic environment and tailor it to the residents' needs (Cromwell, 1967). Finally, the O.T.R. may provide program consultation on matters of treatment and collaborative health planning to those both within and outside the profession.

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SECTION C/ASPECTS SPECIAL TO THE ALLIED HEALTH PROFESSIONS

Part XIX/Physical Therapy

THE ROLE OF PHYSICAL THERAPY IN CARE OF THE GERIATRIC PATIENT

By

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INTRODUCTION

Since maintenance of an active life-style is a prime consideration in all planning for the older person, the physical therapist is ideally oriented to contribute to this effort. The profession as a whole has only recently achieved its clear orientation toward patient activity as the one meaningful therapeutic goal of physical therapy services. In the process, the physical therapist has had to alter his concept of his own role in health care. He is no longer one who applies modalities according to the time-worn "heat-light-water-electricity" definition of physical therapy. Instead, he is now a specialist in assessment and adjustment of human motor performance as it may be compromised by accident and illness. In this capacity the physical therapist is concerned not only with the problems of individual patients who may come under his care, but also with overall planning for the delivery of services to provide for appropriate and effective use of his knowledge and skills.

CURRENT PRACTICE

The role of the physical therapist in the care of certain categories of disability commonly found among older persons has been well established by routine practice. The patient with neuromuscular deficits following a cerebral vascular accident will probably be seen by a physical therapist for assistance in maintaining joint mobility, in reconditioning for a return to upright posture, and in learning to operate the altered motor apparatus that is now his. The physical therapist's first concern will be with bed positioning and passive movement to prevent contractures. In each institution there needs to be mutual agreement between nursing and physical therapy over the proper division of responsibility in providing this early care. The nursing service should also participate in the effort to return the patient to the upright posture. If recumbency is unavoidably prolonged, however, use of special physical therapy equipment such as the tilt table may be required in the management of problems of orthostatic hypotension. Encouragement of early active movement requires the special knowledge of the physical therapist. Recovery of motor control proceeds in recognizable stages and only the physical therapist will be able to identify the level at which the patient may reasonably be expected to perform. Ambulation attempts must also proceed in an orderly progression based on careful assessment of the patient's neuromuscular capabilities at any given stage of recovery.

The physical therapist should also be involved in long-range planning for the patient; in decisions about feasibility of a return to the home; about need for special equipment in the home; about requirement for further physical therapy supervision. If the home situation is to meet the patient's needs, the physical therapist must have an opportunity to discuss in detail and interpret to the family the patient's capacities, limitations, and maintenance requirements.

The care of the geriatric amputee commonly involves physical therapy services. The older amputee generally requires a much more intensive and prolonged physical therapy program because of motor deficits accumulated during a long preoperative period in which activities have been gradually curtailed due to progressive circulatory embarrassment. Immediate postoperative prosthetic fitting is being given more intensive trial. This procedure eliminates accumulation of further deficits during the postoperative prepros-

thetic period. In any event, careful management in graded use of hand support, in preservation of joint motion, and in restoration or maintenance of muscle strength rests with the physical therapist.

Gait training is an area of competence belonging exclusively to the physical therapist. Walking is the most complex motor skill that the average person will ever achieve. All components of normal gait must be combined in a precise time sequence for an efficient and cosmetically acceptable gait. Instruction of the older person may require more time and patience than in the case of younger people because of the heightened arousal of anxiety found among older subjects in learning situations (Troyer et al., 1966).

Patients with musculoskeletal problems due to post-fracture immobilization or degenerative joint disease are also routinely referred to physical therapy. Joint mobility and muscle strength determine the eventual outcome. Where pain is a factor, a high degree of skill is required of the therapist in order to help the patient eliminate muscle guarding of the painful joint and thus assure effective exercise. Even the most determined and eagerly cooperative patient may, without expert guidance, achieve nothing but massive misdirection of effort. Muscle re-education requires patience, skill, and use of a wide variety of special techniques. Patients frequently resent the implication that they are not "trying" but "trying" is not enough; the patient must be taught how to "try right." Furthermore, it is natural to regard any painful activity as harmful. The patient needs support in order to tolerate the discomfort attendant on mobilization efforts. Tolerance for necessary discomforts will be enhanced by instruction in avoidance of noxious and unnecessary discomforts and in positioning and support for comfortable rest.

Physical therapists, like other providers of health services, are in short supply and have been fully occupied with the problems of patients who come to their attention through the recognized channel of physician's referral. They have not had the time or been given the responsibility of deciding how their time and talents might best be employed. The referral system most often brings to the attention of the physical therapist those patients whose mobility is severely compromised as by cerebral vascular accident, amputation, arthritis, or hip fracture. There has been little opportunity for physical therapists to consider the needs of the geriatric population as a whole.

BASIS FOR CONCERN WITH THE GERIATRIC PATIENT

Research on aging indicates certain physiological and histological changes that may take place to a greater or lesser degree as the body ages. Cellular changes in motor units (Gutman and Hanslikova, 1966; Rubinstein, 1961), reduction in nerve conduction velocity (Kemble, 1967; Lucci, 1969), and altered cardiovascular responses (Montoye et al., 1968), indicate some decrement in motor performance with aging. "A considerable body of statistical evidence attests to the fact that, on the average, the ability to exercise and do physical work declines with age. Loss of function during severe exertion is shown in related physiological variables such as oxygen uptake, pulmonary ventilation, diffusing capacity of the lungs, work pulse, and blood lactate concentration" (Barry et al., 1966).

Time and again, however, investigators report a wide range of variability among individuals in an age category. Laufer and Schweitz (1968) for instance, in reporting on seven parameters of sensory-motor performance for subjects grouped by decades from the twenties through the sixties, have published data on separate individuals. In each parameter an individual score can be found in the 60+ group that is superior to that of at least one individual in the 20+ group. Wide variability among individuals gives rise to questions about the relative importance of life habits as opposed to actual organic manifestations of the aging process. Every physical therapist is aware of the effects of deconditioning and should be challenged by this question. According to Pearson (1966), "stereotyped thinking about the presumed inevitable deterioration and decrepitude of aging has been tolerated without systematically investigating the possibilities of retarding or eliminating this particular dimension from the automatic progression of time."

Recently a great deal of attention, both medical and public, has been accorded to programs of cardiovascular conditioning. Such programs employ a time-controlled period of continuous use of the large muscles of the lower extremities to tax work capacity and thus effect gradual improvement in cardiovascular responses to exercise. This is the parameter that is generally referred to in discussing physical "fitness". The programs are useful for their intended purpose but certainly will not suffice, to maintain overall musculoskeletal comfort and sufficiency of the aging individual.

The measures routinely employed in cardiovascular conditioning, both bicycling and jogging, may even aggravate common disabilities of the later years. Bicycling is contraindicated in chondrosis of the patella because of the heavy pressure under the kneecap which is developed by quadriceps contractions over the flexed knee joint. Jogging places added stress on foot and ankle structures that are frequently incompetent to meet ordinary weight-bearing demands. The disuse atrophy of toe flexors and posterior tibial muscles that is almost universal in our adult population could be prevented or corrected but seldom is. However, the possibility of hazard in cardiovascular conditioning processes should not discourage their proponents; instead it should alert them to the need for a judicious selection of means and an adequate assessment and preparation of subjects.

Cardiovascular conditioning, however valuable, is inadequate to meet all the needs of the aging well person. Active living depends upon a sound skeletal framework that is freely articulated and operated with sufficient force. The cardiovascular apparatus can supply raw materials but only the muscles, acting upon skeletal levers, can effect movement.

Scant attention has been paid to the basic requirement of muscle strength as the *sine qua non* for active living. The normal child has muscular energy to spare. He will skip or hop or run when walking would suffice. This surplus of energy-producing potential may continue through early adulthood but the surplus is insidiously depleted by gradual curtailment of physical activity as personal interests and value systems undergo alteration. Ironically enough, strength is the one parameter of muscle function that can easily be improved in any individual with the possible exception of a highly trained athlete. Even professional football players have been known to add to their physical prowess by systematic performance of progressive resistance exercises.

Are we then to accept gradual deterioration in everyday performances of the elderly, the slow uncertain gait, the difficulty in rising from a chair, as inevitable manifestations of aging processes alone? Rubenstein (1961) reports that "skeletal muscles elsewhere than in the muscles of the eye preserve their structural integrity practically throughout life and morphological changes are not expected to become noticeable in them until extreme old age; even then they exhibit a good deal of individual variation which renders their evaluation uncertain."

Some years ago, Perkins and Kaiser (1961) reported substantial gains in muscle strength on each of 2 different types of exercise programs in subjects over 60 years of age. With 3 brief sessions a week for 6 weeks, using subjects whose mean age was 74 years, a 50 percent gain was recorded in maximum force developed by muscle contractions in extension of the hip, knee, and ankle. Furthermore, the gains were retained at the 40 percent level after 5 months without formal exercise. Unfortunately there has been no followup with larger samples of geriatric subjects.

The mounting incidence of falls (Over, 1966) in the later decades should in itself be an incontrovertible argument for encouragement of better muscular conditioning for older persons. Causes of falls have been investigated and hypothesized (Peszcynski, 1960). Vertigo, orthostatic hypotension, and minor strokes may account for some of the accidents which befall the older person. On the other hand, recovery from an unstable posture, as in tripping, calls upon reserves of muscle strength that will be lacking when muscular competence has been permitted to become marginal. Balancing on a pliable supporting structure is, after all, a highly dynamic act. In considering the higher incidence of falls in women (Over, 1966), one might be tempted to speculate about cultural factors which foster a (muscularly) feebler sex and also about footwear best described as deforming enclosures built upon unstable bases.

Regardless of causes, falls in the elderly have more serious consequences because of the prevalence of some degree of osteoporosis. While osteoporosis may be due to many causes, it is frequently the result of inadequate stress and strain on the bones normally created by physical activity and muscle contraction (Bonner, 1969).

The physical therapist is equipped by education and experience to undertake the task of safe, effective application of exercise techniques to geriatric subjects. In their daily practice, physical therapists adapt and modify activity programs to meet individual needs. Under present conditions of practice, however, they seldom see these subjects until deficits have accumulated to precipitate a crisis. The subject who should have been a candidate for general conditioning activities 10 years before, appears with a left hip fracture, a debilitated right lower extremity, an aching back and painful shoulders—and is expected to learn crutch walking.

ORGANIZED SERVICES

The presence of a department of physical therapy within a general hospital does not assure the necessary services for the geriatric patient unless the physical therapy service is clearly charged with responsibilities outside the confines of the department. Attendance at clinics and on hospital rounds provides opportunities for case finding. Medical and surgical services that seldom refer patients to physical therapy should be alerted to the possibility of requesting instruction in bed exercises for any patient who will require prolonged bed confinement. Attendant personnel should be instructed in transfer methods that encourage active participation of the patient. Appropriate use of physical therapy services should be ensured by staff education. Good interdepartmental cooperation depends not only on personal good will but on a sound administrative structure as well. If physical therapy is only an awkward appendage to another department, channels of communication are closed and the department of physical therapy will be unable to contribute its full share to total care of the patient.

While referrals to physical therapy in general hospitals average only about 10 percent of the patient population, a much higher percentage of referral can be anticipated in extended-care institutions. Need for physical therapy may well be the primary reason for an extension of hospital stay. Provision should therefore be made for physical therapy consultation in the initial planning stage to provide a setting that will facilitate delivery of services and encourage patient mobility at all levels of recovery. The participation of the chief physical therapist in determining policies and procedures of the institution is essential if the institution is to provide the environment which will enable the patient to return to his home. The physical therapist in an extended-care institution must also maintain liaison with community services that will be able to smooth the transition from institutional to community living.

As constant supervision is withdrawn, there is always a possibility of regression in the patient's performance. "In the hospital, the patient may respond to instruction in walking along a broad, well-illuminated corridor and up and down conveniently located practice stairs to the point where he is proclaimed independent and ready for discharge. When confronted by the home situation, this same patient may be baffled by the differences in environment and the sudden dependence on improvisation. A little home training and some adaptive equipment will cement newly won physical gains and make the return home a successful venture" (Littauer and Hickok, 1959).

In home-care services the physical therapist may serve only in the capacity of consultant (Meida, 1970) to advise the nurse, to evaluate equipment needs, and to instruct and supervise a concerned person in performance of the home exercise program. Careful interpretation of a patient's abilities and limitations is an important element in successful adjustment to family living. The family must also be warned of the long-term nature of the patient's needs so that initial overprotection and concern will not lead to later rejection.

Services in nursing homes will vary greatly according to the time available. A full-time physical therapist on the staff will be able to contribute much to overall patient care. Attention and concern are in themselves powerful motivating forces. There are indications that the heat lamp and the hot pack are giving way to the tilt table and the exercise mat platform (Kaplan, 1969; Brown, 1970). However, application of exercise techniques requires much more of the therapist's time than application of palliatives. It remains to be seen whether the advent of physical therapy assistants will help to provide optimal care for the long-term institutionalized patient. Economic feasibility will continue to be a major determinant.

PREVENTIVE CARE

Meanwhile there is something that can be done within the limits of economic feasibility. The amount of professional time required for prevention of critical loss of motor competence is small by comparison with the amount of time required for care of the dependent patient. The optimal time for institution of a preventive program is while the patient is living independently in the community. He is then still self-directed and able to carry out recommended exercises and postural practices with minimal supervision, once instructed and alerted to potential problems. As long as individual needs are not neglected group programs could be offered and might enhance motivation for some individuals. Other individuals would undoubtedly prefer to manage by themselves and their privilege of self-determination should be heartily supported. If patient-oriented explanatory literature were developed, better understanding would result in more effective and more faithful performance while instructors

would be free to handle individual questions from a secure base of common knowledge. Active living in the later years would be promoted by physical education on a cognitive level.

Even in the absence of any organized attack on the problems created by physical inactivity in the later years, physicians should give serious consideration to the possibility of referring patients with obvious signs of motor deterioration for instruction in preventive measures. Empiric pessimism about a patient's ability to discipline himself to consistent long-range followup is not warranted. Over the past ten years the author has been instructing patients in management of chronic low back conditions. A followup study now in progress indicates persistence in the exercise program by a substantial number of patients even 7 years after the last contact with the physical therapist. A strong admonition from the physician combined with careful explanation by the physical therapist can have lasting effect.

Granting the need for exercise efforts in the middle and later years, questions might be raised about the need for involvement of health professionals in program planning. General exercise routines are available to all who can read or watch television. Some persons will do fairly well with such programs and be surprisingly persistent in their performance. Needless to say, these are seldom the persons whose need is most urgent.

In general, the exercises are developed by someone who has given no thoughtful consideration to variations in body type and who has no real knowledge of the common deficits of older persons. Such mass prescription of exercise is acceptable only on the theory that any exercise is better than no exercise, and in the prayerful belief that no one will do anything vigorously enough to injure himself.

No program can adequately meet the needs of an individual without some evaluation of that individual's history, life habits, complaints, and personal requirements. Individual performance of each exercise must be observed since movements can be performed in more than one way with differing effects. Furthermore, the subject needs to know the rationale for the exercise and receive instruction in what he should learn to feel as the exercise is performed.

The motor system, being largely trouble-free in its day-to-day operation, receives scant attention or appreciation. Its simple requirements for balanced work and relaxation are grudgingly fulfilled. Its few complaints are generally misinterpreted and often magnified into impending disaster. Discomforts deriving from the musculoskeletal system are almost certain to increase with aging, and the natural response is further curtailment of activity and further loss of work tolerance.

Interpretation of the need for muscular competence is difficult (Hopkins, 1968), but it must be somehow accomplished if reasonable beings are to be expected to devote the necessary time to its cultivation. Anyone who may think the difficulty of the task is being exaggerated should have heard the words of the woman who was being instructed in exercise for a chronic low back condition when she asked, "But might I not get muscles from these exercises? I never *have* wanted to have *muscles*."

Education of even such "hard core" cases is probably possible, given patience, insight, and opportunity. The patience and insight are hopefully available among members of the physical therapy profession but the creation of opportunities to employ these skills in the cause of improved motor ability for the later years is an unsolved problem. Physical therapists attached to nursing homes and home-care organizations as consultants have some opportunity to identify those patients who would benefit most from corrective or preventive measures. The institutional population, however, is but a small fraction of those who might benefit most from well-planned programs of motor activity. There are undoubtedly large numbers of older persons maintaining themselves independently in the community who might prolong their span of active living if given the benefit of specific exercise instruction.

In addition to muscle-strengthening exercises, programs need to include exercises for maintenance or improvement of range of motion. Loss of adequate range of knee flexion, for example, makes it impossible to move the body center of gravity forward over the base of support for elevation from chairs or on stairs. Loss of hip flexion beyond the right angle may never be noticed by the patient, but he will certainly notice the nagging low back ache which forced posterior rotation of the seated pelvis can cause. Rounding of the upper back may begin as a simple postural fault, a surrender to gravity (Hopkins, 1968). The farther forward the head comes, the more effectively gravity works to increase the deformity. Secondary contractures develop, and the deformity becomes fixed. Lung capacity is reduced and the subject can no longer lie on his back because the head will not rest, even on two pillows. The neck must be hyperextended to permit the

eyes to look straight ahead and symptoms of nerve root irritation may involve the upper extremities.

Although senile kyphosis may be associated with osteoporosis of metabolic origin, this still does not mean that the deformity must be allowed to progress unchecked. A 5 to 10-minute period of recumbency in the hook lying position, supine on a hard surface such as the floor, can control progression of the curvature. In this position, gravity becomes an ally instead of an enemy. A measured height of headrest sufficient to permit relaxation but not real comfort is used as required. The headrest is layered (books or magazines serve admirably) to permit easy removal of a section at a time. Usually some lowering of the headrest will be well tolerated after the first several minutes of recumbency. After several weeks, initial headrest height can usually be reduced without undue discomfort and work can begin on the next decrement. While gravity is collaborating, the patient is taught how to hold the chin down and actively reach the head down toward the floor. In this way, muscle strength is developed to help hold the correction. Even if the patient neglects active postural correction when erect, some seating arrangement may be contrived to lessen deforming forces.

Although the years may bring their rewards of insight, detachment, and equanimity, the process of aging cannot always be warmly welcomed. The "high-maintenance years," as they have been called, certainly have their slings and arrows. If medicine is to continue to prolong man's span of years, then it is time for medicine to enlist physical therapy in a commitment to prolong the active years. Aging is one thing, and premature surrender to aging is another. "Until we can foster a program to develop and maintain sound physical health and stamina, we are likely to see a large portion of our citizens deprived of their potential by the simple virtue of poor physical capacity to realize it." (Pearson, 1966) An ancient automobile may be in a junk yard or it may be in an antique car show. It all depends on maintenance.

PATTERNS OF PRACTICE

The effectiveness of any health profession depends upon delivery of service at the right time to the right patient, with full responsibility for the exercise of judgment within the area of special competence. Physical therapy first emerged as a technical occupation observing a prescriptive relationship with the physician. Prescriptive relationships preclude treatment based on evaluation of the total patient, modification of procedures on the basis of observed responses, and development of a teaching relationship with the patient. It is this latter relationship which is absolutely essential in any physical therapy program directed to the geriatric patient. Effective maintenance of physical capacities requires that the patient be helped to full understanding of his problems and of possible solutions. Without full freedom of both application and explanation the whole process becomes one of shoddy rote and meaningless drudgery.

As physical therapy has emerged into professionalism, the prescriptive relationship with medicine has become largely obsolete (Michels, 1968). Each of the many disciplines that now contribute to patient care has its own area of special competence. At their centers, these areas are readily distinguishable, one from the other. At the periphery, they may frequently merge and overlap. With professional development, however, these overlapping areas cease to become sources of conflict, and become instead areas of mutual understanding and cooperation. The professional who is secure in his own area of competence will recognize and support professionalism in other areas of specialization.

At the present time, physical therapists have elected to retain a referral relationship with physicians in matters of direct patient care (American Physical Therapy Association, 1969). This leaves as a gray area participation by physical therapists in community programs for older persons where individual assessment and adaptation of programs to individual needs would logically be carried out. It is unlikely that such activity would be viewed unfavorably by the professional association (American Physical Therapy Association, 1968). Patterns of care both in institutions and in the community are bound to change as stratification develops within the field.

Case Western Reserve University has been the pioneer developing a program of basic physical therapy education at the master's degree level. Other universities have adopted this basic approach. Doctoral programs are also being developed specifically for the field of physical therapy. In addition, many physical therapists who have completed doctoral studies in the basic and social sciences have returned to the field as researchers and educators. Forcing upward mobility from below are the rapidly developing programs for physical therapy assistants at the associate degree level

under the sponsorship of the American Physical Therapy Association (1970). All of these efforts should result in greater availability of quality care for the geriatric patient.

Physical therapists with adequate background in administration should become available as nursing home consultants with trained assistants to supervise day-to-day activities of aides. The personnel needed to carry out clinical research on exercise needs of older persons should also become available when tasks not requiring their level of competence can be delegated to well-prepared assistants. Meanwhile, under current referral practices, the physician must take responsibility for case finding in the community at large. Each request for evaluation and exercise planning for long-term self-administration by the patient has potential for maximum return on a small investment of professional time. Accrued benefits may extend well beyond simple physical capacity to meet daily needs since "the enhancement of physical attitude affects all other aspects of well-being" (Pearson, 1966).

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SECTION C/ASPECTS SPECIAL TO THE ALLIED HEALTH PROFESSIONS

Part XX/Podiatry

PODIATRY AND THE ELDERLY PATIENT

By

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GENERAL CONSIDERATIONS

The foot probably has received the least amount of attention of any part of the human body. Though it is seldom the cause of mortality, it is often the cause and site of morbidity, disability and limitation of activity. It has also been well established that due to the anatomical and physiological relationships and functions of the foot, many initial signs of systemic disease are first manifest there. With the advent of chronic disease as the Nation's number one health problem, and the growing stress being placed upon geriatric and long-term care, much attention has been focused on the need to maintain an ambulatory capacity among the chronically sick and elderly.

If the precepts of progressive patient care are to be maintained, and if total and comprehensive health services are to be established for the aged and chronically ill, community podiatry programs must be initiated to achieve three very important goals in gerontology, i.e. to limit disability, to preserve maximum normal function, and to restore the highest possible level of independent activity to the patient. The maintenance of ambulation will help senior citizens keep their self-respect and motivate them to accept their own health responsibilities.

The modern advances in health have added years to life. Today, a person's health is dependent upon a wide variety of measures, comprising both the physical and social influences of his environment. One of the most important of these influences is the availability of good health care, including a wide range of preventive, therapeutic and restorative services. The inclusion of foot health in this comprehensive approach will add greatly to these overall goals.

The podiatry profession knows that the health care it renders is an essential part of a total health service. It has long recognized that its services must be integrated with those of the other health professions in order to provide continuous service and care for the patient, for his family, and for the community as a whole. Once the elderly person loses ambulatory ability, the resultant socioeconomic changes created by his home-bound status may be very considerable. It is well to remember that the feet are the fourth most common source of discomfort in the aged person and have often been called the mirror of health.

Since the etiology of most of the chronic diseases is unknown, primary prevention is not possible at this time. But many general pathological conditions can be discovered during the course of a podiatric examination, interview, or treatment program. This additional health appraisal thereby enhances the likelihood of secondary prevention of some chronic disease by permitting early diagnosis prior to the onset of specific symptoms or the development of overt abnormalities. It is at this point that suitable therapy can be instituted and often the patient's future health safeguarded.

The pedal complications of the various systemic, cutaneous, and functional diseases of the human body can produce varying degrees of disability. It is well accepted that a patient, once moving about, will more readily accept other therapeutic regimens, thus reducing periods of bed confinement.

Many pedal conditions can become chronic and require continuous management. If untreated, they may cause chronic impairment and disability resulting in the loss of ambulation and the creation of physical, psychological, social and economic burdens to society.

PEDAL CHANGES IN DISEASE AND AGING AND OBJECTIVES TO OFFSET THEM

To better understand the importance of foot health in the care of elderly people, it is necessary to briefly consider the wide variety of changes which take place in the human foot due to disease and aging.

The skin is one of the first structures to demonstrate changes. The earliest sign is usually the loss of hair along the outer side of the leg and on the dorsum of the foot. Brownish pigmentations follow with an associated increase in the presence of hyperkeratotic areas due to keratin dysfunction. Added to this, some loss of muscle mass and soft tissue in the foot occurs. The nails have a tendency to become thickened and brittle and onychomycosis seems to be more prevalent.

There are numerous changes in the musculoskeletal structures of the foot. Due to wear and tear, repeated trauma, years of abuse and decreasing arterial supply, the feet are easily fatigued and there is a consequent decrease in work tolerance. With the associated loss of muscle and soft tissue mass, there are frequent complaints of leg and foot cramps, which may or may not be associated with arteriosclerosis. Osteoarthritis, hyperostosis, senile osteoporosis, fixed deformities and marked limitation of motion are also noted and further contribute to the problems of ambulation.

The vascular system demonstrates trophic changes, coldness, pulse changes, and color variations. Arterial pathology can turn simple abrasions into gangrenous lesions.

Aging and chronic disease also produce many functional changes in the foot. Among these are a loss of sensation, complex gaits, reduced agility and tremors.

It is easy to demonstrate the needs of early diagnosis of foot pathology in order to achieve rehabilitation and maintenance of foot health at its maximum level. Three distinct relationships exist between podiatry and the chronic diseases in general:

1. Many general pathological conditions can be discovered during the course of a podiatric examination, interview or treatment program.
2. Persons with some chronic disease require podiatric care to control the pedal sequelae, as well as the pathologic changes of the feet associated with aging.
3. Many pedal conditions may become chronic. If untreated, they may result in a loss of ambulation and a furthering of disability from other causes.

Although members of the health professions are primarily concerned with the prevention and treatment of disease, the elderly person's concerns are largely those of maintenance of the ability to see, hear, eat, and walk about. He or she needs to move about to see friends, pursue a hobby, make life more enjoyable, and lead a useful life as a member of his or her community.

The treatment of the foot is not usually surrounded by urgency and there is seldom, if ever, the matter of life or death. Complaints are usually those that take joy out of living. Many times, moreover, a patient will present himself to a podiatrist with no history of a physical examination during the past several years, and it is in these situations that podiatry can strengthen comprehensive medical care by appropriate referrals and consultations.

Foot health is needed by the individual patient to:

- Increase personal comfort.
- Lessen the possiblity of medical or surgical complications.
- Reduce institutional care.
- Reduce or eradicate the likelihood of hospitalization as a result of a foot infection.
- Remove some of the stress and strain of foot discomfort.

The ultimate objective in all this is to maintain the individual in a state which makes him capable of ambulation to the maximum degree.

CIVILIZATION'S EFFECTS ON MECHANICAL FOOT PATHOLOGY

The major functions of the human foot can be classed as static and dynamic. The foot is an efficient organ of propulsion and locomotion. It is a relatively rigid structure, and through the years must carry a physical workload only excelled by organs such as the heart. No other portion of the human body is forced into a limiting enclosure and forced to continually pound, time and time again, the hard surfaces which civilization has forced upon modern man.

The human foot is a complex organ composed of some 26 bones and ossicles, and ligaments, muscles, tendons, arteries, veins, nerves, and skin. The normal foot bears weight on a triangle, with the long sides being the inner and outer longitudinal arches, and the base or short side being the five metatarsal heads. Weight is transmitted from the calcaneous to the first and fifth metatarsal heads, where the angles of the triangle are made up.

Civilized society produces many changes in the nor-

mal physiologic functioning of the human foot. Primary concerns are the hard, flat walking surfaces which do not absorb shock. Paved sidewalks, streets, and hard floors provide flat surfaces which do not permit weight distribution over the entire foot. Thus, total foot function is not permitted and limitation is put upon the intrinsic muscles especially. A prime example of this is the atrophy of the interossei and the resultant diminished function of toe action, associated with digital contractures.

The primary effect from this is repeated tissue trauma which creates stress on one particular area. Flat, hard, surfaces further cause the foot to be maintained and function in a single attitude.

Tissue trauma results in osteitis, periostitis, synovitis, capsulitis, fasciitis, myositis, arthritis and fibrositis. Many times these painful pathologies and pathomechanical entities are created by an attempt to restore the so-called anatomical norm. However, correction of the anatomical attitude may not restore good function. This is particularly true when an individual is hindered by the processes of aging and his ability to adapt to change is limited.

Pathomechanical problems arise from the interaction between normal morphological variations, the capacity to adapt to stress and the stressors acting on the foot.

Morphologic variations may be intrinsic, i.e. within the foot itself, or extrinsic, such as changes in the physiological relationship between the foot and legs, knees, thighs, hip and back. These changes can be derived from either bone or soft tissue.

The common intrinsic bony changes are usually associated with the forefoot (toes and metatarsals) or the rear foot (calcaneous and talus). It is possible to cite as examples the hypermobile first segment, pes cavus, the shape of the navicular and the presence of a subtentaculum tali. Any or all of these produce changes which mandate individual adaptation.

The ability to adapt to stress is dependent upon the neuromuscular apparatus and vascular supply. The neuromuscular apparatus controls reflexes, and in particular the conditioned reflexes. It also controls anteroposterior and lateral stability of the foot, and muscles serving as the prime movers, the antagonists, the synergists and those dealing with the role of fixation.

The vascular supply controls all problems of nutrient and end product transport.

The stressors which affect the foot can be classed as those of mechanical origin and those of systemic disease.

Mechanical stressors are two in nature. The first might be termed macrotrauma, which results from sudden injuries which do not permit an opportunity for individual adjustment to stress. An example would be sudden injury with a resultant fracture. The second mechanical stressor might be termed microtrauma which is derived from the hundreds of thousands of tiny injuries resulting from occupational actvities overweight, poor stance and gait and foot to shoe incompatabilities.

The systemic stressors can be classed as the pedal manifestations of disease such as arteriosclerosis, arthritis and diabetes.

It is obvious that the foot cannot be divorced or segmented from the body, nor can the foot itself be segmented. It is thus evident that the foot must be considered as the "end" organ of locomotion and that the resultant mechanical, rotational or positional changes comprise parts of a syndrome or a chain of events of a progressive process. Once a link in this chain breaks, every effort must be made to prevent further damage and minimize the associated complications of an ongoing process.

Treatment should be aimed at eliminating the cause of the abnormality and at bringing about redistribution of weight to nonpainful areas of the foot. It should be remembered there are variations between individuals and, from time to time, within an individual in the capacity to adjust to change. The primary aim in dealing with pathomechanical problems is to restore maximum function.

A change in the mechanical structure of the foot calls for early determination of etiology and steps to prevent further alterations. Otherwise the resultant series of related structural changes and the variety of objective and subjective symptoms will produce limitation of activity and further disability. The therapeutic and preventive measures must depend on the particular stage in the progressive chain which is presented at the time of evaluation.

COMMON FOOT PROBLEMS

During the course of a lifetime, the human foot undergoes a great deal of trauma, use, misuse, and neglect. The various stresses involved in daily activity, the continuous enclosure of the foot, and the overlying

degenerative changes of aging require special attention if the individual is to remain ambulant.

The most common, chronic foot problems of a local nature are those associated with the skin, the toes, and the pathomechanical changes in foot function. Attempt will be made in the following portions of this section to discuss the common everyday complaints associated with the elderly patient.

Dermatological Problems

The most common signs of aging skin are dryness, scaling, and atrophy. Causes for these changes are undoubtedly varied and multiple. Considered as prime factors in these changes are diminished sebaceous activity, diminished hydration of the horny layers, metabolic and nutritional alterations, and dysfunction in keratin formation. There is loss of hair, loss of skin elasticity and the nails become striated and brittle. These are various degenerative changes, and pigmentation is common. The presence of varying degrees of occlusive vascular disease produces many color changes and creates an increased deposition of hemosiderin in the soft tissues. This factor further contributes to disturbed keratin formation.

Pruritus is common in the aged foot. It may be due to disturbed keratin formation, dryness, scaliness, decreased sebaceous activity, environmental changes and defatting of the skin as the result of continuous hot baths. It must be differentiated from chronic tinea and various neurogenic and emotional dermatoses. Treatment should consist of daily applications of emollients which hydrate and lubricate the skin, and medications to break the scratch reflex.

Often associated with pruritus, the initial complaint may be dry skin. Therapy again consists of emollients that hydrate and lubricate the epidermal structures. Oil and water baths are also of value in these cases.

Fissured heels can cause a serious problem when there is an associated poor blood supply to the heel. The broken skin presents an excellent avenue for bacterial invasion and subsequent infection. A secondary tineal involvement should always be considered. Therapy should be aimed at closing the fissures and at future prevention; heel cups and emollients are utilized for this. When there is an overlying tineal or bacterial infection, initial therapy is aimed at these etiological factors. It should be noted that contact dermatitis should be considered in resistant cases.

Anhidrosis is common in the geriatric patient and requires hydration and lubrication of the skin.

Hyperhidrosis is less common due to gland atrophy. It is many times associated with tinea and with various types of foot coverings. It may also be associated with various emotional factors. Local therapy begins with daily hygiene and the application of a good foot powder to absorb moisture. Peroxide and alcohol swabbings and the application of mild formalin solutions are of value in resistant cases. The topical application of anticholinergic preparations, as well as their systemic ingestion should be considered.

Bromhidrosis is a form of excessive sweating characterized by a fetid odor due to a chemical decomposition of sweat. The therapeutic approach is similar to hyperhidrosis with the addition of formalin in the early treatment period.

Contact dermatitis from shoe dyes and various foot covering materials should be considered when the patient presents a limited and circumscribed area of inflammation and a previous history of allergy. The primary irritant must be isolated and removed. Therapy must then be aimed at the various dermatologic manifestations present which usually includes mild soaks with such solutions as Burrows or saline and topical application of steroids and related drugs.

When pyodermas or "superficial infections" are present, they can be serious. Due to the various degenerative changes associated with aging, any break in the skin can result in a bacterial infection. Therapy consists of warm soaks and appropriate antibiotic therapy, both topical and systemic.

Tinea pedis may be present in any one of its clinical varieties, i.e. acute vesicular, subacute vesicular, chronic hyperkeratotic and the various varieties of intertrigital infestation. Smears and cultures can be used to confirm a diagnosis. However, due to the time necessary to culture organisms, therapy should be instituted with a presumptive diagnosis. Griseofulvin is of value. However, its effectiveness is related to the integrity of the vascular tree. In the acute stages, soaks and the topical applications of the various fungicidal preparations should be used. Castellani's paint and gentian violet are welcome additions to intertrigital therapy. Tolnaftate, undecylenic acid and iodochlorhydroxyquin preparations are also of merit. Where there is an overlying bacterial infection, antibiotic therapy must be used in conjunction with the above. When the etiological factor of tinea pedis is candida albicans, antimonilial drugs should be employed.

There are various forms of ulceration which are present on the aged foot. A small variety are the result

of pressure from overlying hyperkeratotic areas and external or internal trauma. Therapy in these cases consists of adequate debridement, drainage, and the elimination or control of the etiological factor.

The vast majority of ulcerative lesions of the foot are the result of local pressure in association with a systemic disease, the most common being diabetes and arteriosclerosis. In all cases, blood sugar determinations to eliminate diabetes and X-rays to eliminate bone involvement should be initial therapeutic approaches. Careful debridement of the area and the application of various topical enzymes have proven of value. All attempts to remove weight bearing and pressure from these areas should be instituted and physical measures to improve the vascular supply to the area initiated. The ultimate success of treatment is dependent upon total cooperation between all members of the patient's care team.

It should be pointed out that any one of a wide variety of dermatological conditions can be present in the foot. Again, due to the need to maintain ambulation, all-out professional cooperation is a must.

Onychial Problems

The elderly individual's chief nail complaints are usually concerned with thickness, hardness, and an inability to cut his own nails. These simple problems can become magnified by poor eyesight and the inability to bend.

The etiological factor in geriatric nail pathology is due to trauma and various disease entities such as infectious dermatosis and degenerative diseases such as arteriosclerosis and arthritis. In the following paragraphs of this section there will be an attempt to define proper management as classified by cause.

Congenital. Examination of the geriatric patient may demonstrate anonychia (absence of nails), macronychia (enlarged nails), and micronychia (small nails). These conditions are asymptomatic. Congenital thickening of the nail may sometimes be present and the treatment is periodic debridement, accompanied by home care measures.

Trauma. A sudden traumatic blow to the nail can result in a subungual hematoma. This condition is quite painful and hemorrhage can usually be seen through the translucent nail plate. A small hole is drilled through the nail plate with a drill to permit blood to escape. This usually results in immediate relief of pain. X-rays should always be taken to rule out the possibility of a fracture of the distal phalanx. Following any acute trauma and injury to the matrix (nail root), thickening usually results. A severe injury to the matrix may also cause loss of the nail, starting at the proximal end. Beau's Lines (transverse striations) may be present when nail growth is interrupted, even though the injury or disease is not severe enough to cause shedding. This can be demonstrated many times following a myocardial infarction.

Onychauxis is a thickening of the nail plate and is associated with aging, nutritional disturbances, repeated trauma, inflammation, local infection, various infectious diseases such as lues, and various degenerative diseases such as arteriosclerosis. The nail is thickened, discolored and onychophosis (callus nail groove), subungual hyperkeratosis and debris are common. Onychomycosis can usually be found with this condition in the geriatric patient. Pain may be present due to the pressure of the nail plate pressing against the distal phalanx or the upper part of the shoe. Treatment is aimed at the cause with periodic debridement of the nail plate serving as the initial approach.

Onychogryphosis is an unusually large and curved nail with treatment similar to onychauxis.

Onychophosis (callus nail groove) is usually the result of microtrauma on the nail plate from some external pressure. Treatment consists of excision, the use of emollients which hydrate and lubricate the hyperkeratosis, thinning of the nail plate to permit flexibility, and removal of any external pressures. Surgical onychoplasty provides a permanent cure.

Onychocryptosis (ingrown toe nail) occurs when a fragment of nail pierces the skin of the ungualabia (nail lip). It may be the result of improper self-treatment or external pressure. It is usually accompanied by secondary infection and by granulation tissue in longstanding cases. Conservative treatment consists of partial excision of the nail, followed by saline soaks, topical antibiotics and packing. When extended infection is present, systemic antibiotics are employed. Management can be complicated by a thickened nail. This condition can be quite serious when there is an overlying systemic disease such as arteriosclerosis and diabetes. Neglect by the patient in these circumstances can result in gangrene. When this condition becomes chronic in nature, surgical excision or cautery of a portion of the nail matrix or onychoplasty must be considered to prevent further infected states.

Subungual heloma may result from pinpoint pressure on the nail bed. A subungual exostosis spur, or

chondroma must be ruled out by X-ray. The lesion usually appears as a dark spot beneath the nail plate. Treatment consists of excising the lesion and the removal of pressure. Where bony projections are presented, surgical excision is indicated. A subungual melanoma may present a similar dark appearance through the nail plate and must be ruled out prior to treatment.

Allergic manifestations in the ungual area may be due to primary irritants such as bacteria and fungi or from repeated exposures to secondary irritants such as nail polish and shoe dyes. The cardinal signs of inflammation (onychia) are usually present, and are followed by onycholysis (separation of the nail from the bed, starting at the free edge). Treatment is aimed at eliminating the cause followed by chemotherapy for both infection and inflammation. Topical steroids are of value in chronic cases. Subungual hyperkeratosis may be present and repeated curettage is useful in this instance.

Nutrition plays an important role in all body structures. In poor nutritional states, the nails usually become thin and brittle and lose their luster. Onychomadesis and Beau's Lines may also be present. Therapy is aimed at the primary etiologic factor.

Onychomycosis is a fungus infection of the nail which usually causes a severe disturbance of nail growth accompanied by local nail plate destruction. The common organisms of note are the mentagrophytes, the rubrum, and monilia. The monilial variety is rare and moist in character. The rubrum causes a dry infection with greater destruction than the mentagrophytes.

Onychomycosis can be incapacitating as exhibited in mycotic onychauxis and always remains as a focus of infection and reinfection. The nails appear opaque, scaly and hypertrophic. The areas of destruction may be granular and accompanied by onycholysis. Onychia and paronychia may be complicating factors.

Treatment includes smear, culture, surgical debridement, chemical debridement and the use of antifungal agents. Griseofulvin can be utilized, but its results are dependent upon the arterial supply to the nail bed. Topical preparations such as borotannic acid complex and tolnaftate require meticulous care by both the patient and the podiatrist. This condition is notably resistant to treatment, and much still needs to be learned about the fungal diseases and their relationship to general health.

Nail infections can be caused by all of the varieties of bacteria and other organisms. The cardinal signs of inflammation are always present as demonstrated by onychia and paronychia. Therapy consists of warm saline soaks and antibiotics. Amphotericin B should be employed when monilia are present. Chronic paronychia is common in diabetes and must always be considered.

Any one of the various *neoplasms* may affect the nail area. Their differential diagnosis considers verruca, subungual heloma, subungual exostosis, subungual chondroma, glomus tumor, fibroma, melanoma and senile keratosis. Therapy depends upon the etiology.

Other Pathological Conditions may be associated with nail abnormalities:

Psoriatic nails are usually opaque and lose their luster. Onycholysis, subungual debris, retarded growth, and Beau's Lines are common. Onychia punctata is the classical diagnostic sign.

Long-standing *eczema* usually demonstrates a disturbed growth pattern and a marked nail distortion. Long-standing *endocrine disturbances* usually produce atrophy of the nail plate and surrounding tissues.

Vasospastic conditions usually produce atrophy and widening of the eponychium (cuticle). The *organic vascular diseases* such as arteriosclerosis and Buerger's Disease usually produce local ischemia and retarded growth. Onychorrhexis (linear striations) and onychauxis are usually also present. When there is an associated diabetic and vascular problem, minor nail pathology can result in hospitalization and amputation, if neglected.

The nails of the *arthritic patient* are usually dry and brittle with onycholysis, onychorrhexis and onychauxis being common. *Leutic* nails usually demonstrate paronychia in the early stages and hypertrophy in the latter stages.

The above section merely represents common geriatric nail problems and is by no means limiting.

Pathomechanical Problems

One of the most common complaints of the geriatric patient is centered about the various hyperkeratotic lesions (corn or callus). In the absence of overlying cutaneous disease, these are due to various anatomical and pathomechanical changes. They are always secondary to some other etiologic factor. If neglected, they can become incapacitating. There is a common misconception that shoes are the cause of all foot problems, but studies always reveal some anatomical or pathomechanical change in the human foot. The true etiologic

factor is repeated microtrauma to an area of the foot by continuous pressure, sometimes combined with congenital and hereditary tendencies.

The most common mechanical problems which result in pain, deformity, and the development of hyperkeratotic lesions are as follows:

- Pes planus
- Pes valgoplanus
- Imbalance
- Acute strain—fasciitis, myositis and tendonitis
- Hallux valgus
- Digiti flexus
- Digiti quinti varus
- Phalangeal rotational defects
- Phalangeal hyperostosis
- Disturbed metatarsal length patterns
- Morton's syndrome
- Bursitis and, in particular, anterior metatarsal bursitis
- Morton's toe and neuritis
- Absence of plantar soft tissue
- Hallux limitus
- Calcaneal spurs
- Local changes due to degenerative bone joint and soft tissue pathology

Diagnostic and Treatment Principles

A history taken from the patient, good as it may be, merely provides the starting point for a total podiatric evaluation. Diagnosis should include appropriate laboratory tests and X-ray examinations. Where pathology exists, standard static X-rays can be utilized. Where the problem is one of pathomechanics and foot dysfunction, dynamic weight-bearing studies and special projections must be utilized. It must be remembered that the foot is an organ of locomotion, and diagnostic and treatment programs must be aimed at complete restoration of maximum ambulation.

In the treatment phase, appropriate medications should be utilized when indicated and various physical measures such as hydrotherapy, ultrasound, low voltage therapy, and exercise are employed to promote maximum function.

Adequate footwear which gives proper support and protection is of value when it is accompanied by the utilization of molds, inlays, and shields which diffuse, disperse, and redistribute the various pressures and weight from painful conditions.

In recommending a shoe for an aged patient, one of two different problems are usually dealt with: the person who lives at home and goes about normal and usual community activities or the person who is confined to limited activity in an institution. The patient who is living at home and maintaining his usual and normal community activities should procure shoes that provide adequate protection and support and meet the occasion for which they are being used. In the case of the older patient, the problem may be quite different from that of the young because of differences in physical demands.

It is of prime concern that shoes and stockings be acquired to fit the requirements of the patient; shoes that feel comfortable when tried on in the shoe store; shoes that conform to the shape of the individual's foot. When deformities such as hallux valgus (bunion) exist, special shoes or modifications should be utilized which compensate for these deformed and altered foot contours. The older person should be warned about wearing hand-me-downs, as this method of obtaining shoes can result in serious foot trouble. The most important factor in shoe fit is a foot-to-shoe last (shape) compatibility.

Most women wear high heels in their earlier years. Depending on the height of the heel and the length of time worn, a short or tight heel cord can be created. High heels also change the weight bearing surface of the foot and reduce the total area in contact with the plane of support. This reduction in contact causes greater stress on the contact areas. It is observed that many older people still need some heel height, but this should be limited to a medium heel (8/8—12/8), which offers greater stability to the foot. At times, modifications are made to the heel, such as lateral extensions to offer greater contact area to the heel.

The "orthopedic shoe" per se is not a corrective device, but intended to compensate for some preexisting condition, deformity or weakness. They should only be used and/or prescribed following adequate pedal evaluation, including radiographic studies. It is here that extended cooperation between members of the patient's health team can prove most beneficial to the patient, as overall health must be considered. Where deformity exists and the patient is unable to obtain a standard last or other commercial special last, a made-to-order shoe may be necessary.

Mention should also be made of the "molded shoe." A made-to-order shoe will generally resemble a standard shoe with special sizes or modifications built in. A molded shoe usually conforms to the shape of the foot, and the sole or inner surface conforms to the

total weight-bearing area of the foot. Its basic advantages are to reduce shock, provide a shape to fit the foot, and provide a greater distribution of stress to help compensate for painful conditions. Judicious evaluation and prescription should be employed and commercialism should be avoided to protect the safety of the patient.

Patients confined to institutions usually do little in the way of physical activity. Their periods of ambulation are limited, but even so, care should be maintained in the selection of appropriate footwear to meet the occasion. In these instances, the basic purpose of the shoe is to afford protection, and the upper should be of a soft, flexible material to eliminate undue pressure. Inasmuch as many elderly people are unable to bend or tie laces, a slip-on type and a long shoe horn will enable many to do for themselves. It is suggested that in order to add greater stability to the foot during ambulation, full foot coverage with counter and full upper be provided, as opposed to an open sandal.

SYSTEMIC DISEASE OF THE FEET

Local Complications of Systemic Disease

A descriptive listing of diseases which manifest themselves in the foot would provide a prohibitively lengthy text. Rather it is the intention here to identify those that are common and to briefly describe their clinical manifestations and their primary complicating effects.

It should also be recognized that although many diseases present foot symptoms as initial complaints, the usual response in the elderly is toward the most overt abnormality with its varied complaints and symptoms. The individual is often faced with complications arising from various sources which make the podiatric care of the elderly anything but "routine," no matter how common is the condition. As an example of this, most old people develop thickened nails, the treatment of which is considered by many to be routine. However, elderly people also are prone to have some form of cardiovascular disease and thus, since this is common, its treatment might also be considered routine. But in fact, neither condition should be taken lightly and both must be managed to maintain the functional activity of the patient.

The initial consideration is one of patient management. The term can mean many things to many people, but in the aging or aged individual, it denotes a more serious problem than a behavioral and communication problem because of the real or potential dangers involved. It refers to the fact that elderly patients require care and treatment that is not routine, but has special understanding and special knowledge about unusual problems. Looking at the elderly patient, it is essential to see him or her as an individual with unusual sensitivity to drugs, a high susceptibility to infection, a lower threshold to physical and emotional stress, one or more serious systemic diseases and impairments, tissue that does not heal or repair readily, and a tendency to injure his lower extremities, thus reducing ambulation and producing a greater mortality risk.

Foot infection, with and without gangrene, is by far the major local complication in elderly people related to systemic disease entities and other factors. This situation often results in the necessity for amputation, and even in loss of life or the will to live. In general, one can identify the etiologic aspects of foot infection in the aged as those associated with:

a. *Trauma*, such as a cut, abrasion, or the result of crushing, blistering or pinching that breaks the intact skin.

b. *Neglectful acts*, such as poor hygiene, particularly poor-fitting footwear resulting in a foot-to-shoe incompatibility and the production of blisters or raw areas. Impaired vision can turn "routine" foot care into hospitalization.

c. *Changes due to the aging process in the skin*, such as fissuring, dryness, hyperkeratoses and atrophy.

d. *Metabolic changes associated with systemic diseases*, such as those seen in diabetes and peripheral vascular disease.

e. *Primary and secondary skin diseases.*

f. *The end result of some surgical procedures.*

Osteoarthritis or degenerative joint disease can usually be identified in the elderly in its primary form or as secondary to trauma, inflammation or metabolic changes. The associated relationship between chronic trauma or strain and obesity is well reflected in the weight-bearing joints of the foot. Osteoporosis and postmenopausal syndromes also can be demonstrated often in the same individual. The primary findings in the foot include pain, stiffness, swelling, limitation of movement, and deformity. Clinically, diagnostic associations may include plantar fasciitis, calcaneal erosions and/or spur formation with or without periostitis, osteoporosis, stress fractures, tendonitis and tenosynovitis. Where *osteochrondritis* was present at an earlier age, the end result is usually an osteoarthritic joint.

Existing deformities such as pes planus, pes cavus, and digital deformities such as hallux valgus, hallux rigidus and digiti flexus provide for increased pain, limitation of motion and a reduction in the ambulatory ability of the patient. The primary factor to consider is that osteoarthritis in the foot is usually secondary to repeated microtraumata and may be precipitated by inadequate foot care at earlier ages.

Traumatic Arthritis can be well demonstrated in the foot by the clinical entity of hallux rigidus and its earlier form, hallux limitus. Continued primary trauma to the first metatarsalphalangeal articulation provides the etiologic factor. In the elderly, the clinical feature resembles a monoarticular osteoarthritic joint. However, the bony bridging provides the need for patient mechanotherapy, as well as surgical consideration.

Neurotrophic Arthritis when identified in the elderly patient may be manifested by the atrophic changes seen in diabetes and by the hypertrophic changes seen in tabes. These represent the common diseases producing this form of joint disease.

Infective Arthritis can be present in the elderly patient as the end result of a single septic process of the joint and is associated sometimes with osteomyelitis. It may also be the residual of tuberculous, gonococcal or syphilitic joint disease.

Gouty Arthritis is the most common metabolic arthritic process. Clinically, the disease may provide symptoms in any joint of the foot and should always be suspected where intense pain is present without trauma. The primary manifestations in the elderly are related to chronic tophaceous gout and include chronic, painful, stiff joints, soft tissue tophi and a loss of bone substance.

Rheumatoid Arthritis in the elderly patient usually is presented as the end result of the disease with exacerbations of pain, joint swelling, stiffness, muscle wasting and deformity. Residuals in the foot include: painful pedal joints, hammer toes, forefoot spreading, progressive hallux valgus, calcaneal erosions, fasciitis, tendonitis, cystic and sesamoid erosions, fused digital articulations, phalangeal reabsorption, extensor tendon displacement with deformities, pedal rigidity and spurs.

Diabetes Mellitus is well known to be complicated by many pedal manifestations. Very often foot symptoms appearing in an individual who is not known to be a diabetic will lead to detection of the disease. The pedal manifestations are related to multiple systems and often are associated with a variety of symptoms and signs such as paresthesias, sensory impairment, motor weakness, reflex loss, neurotrophic arthropathy, muscle atrophy, absence of pedal pulses and the clinical findings of peripheral vascular impairment. Other common findings are dermatophytosis, chronic inflammation and infection, ulceration and terminal gangrene.

The dread neurotrophic or diabetic ulcer is resistant to treatment and requires a multifaceted approach. The best treatment is prevention by the continual management of even minor foot problems. For example, ulcerations can be precipitated by continuous pressure causing local vascular impairment, penetration of tissue with trauma, and continued friction with thrusting and shearing of the plantar structures. The initial doctrine of prevention must be initiated by recognizing the liability and providing health education to the patient and his family. Management must include a multidiscipline approach.

Peripheral Vascular Insufficiency is present in the elderly patient in varying degrees. Overt indications of decreased arterial supply in the feet are muscle fatigue, cramps, claudication, pain, coldness, pallor, paresthesias, burning, atrophy of soft tissues, trophic dermal changes such as dryness and loss of hair, absent pedal and related pulses, and decreased changes in the various functional tests, such as oscillometric readings, histamine wheal, etc. Many times, calcification can be demonstrated during the course of a podiatric X-ray examination. Often pain is mistaken for pathomechanical faults and blamed on "arch conditions" when the real problem is a lack of oxygenated blood to the part.

The terminal result of peripheral arterial occlusion, gangrene, can be well related to other factors such as smoking, occupation, exposure to cold, and cardiorenal pathology.

Edema, either related to cardiorenal disease or dependency, may be the first real sign of impending peripheral arterial complications.

Pedal ulcerations in the aged, associated with arterial insufficiency, are extremely slow-healing and are many times complicated by diabetes mellitus. The loss of collateral circulation and the possibility of occlusion from vasospasm provide an ever-present liability to the patient.

The peripheral circulation should have adequate support in patients leaving bed following a period of immobilitation. Edema of the feet and ankles due to a combination of inactivity, dependency, immobilization,

pain, muscle inactivity and venous insufficiency creates substantial complications. Venous insufficiency, with and without varicosities, leads to ulceration and stasis dermatitis. Topical infections must be considered as serious complications, and early treatment and management must be employed.

Paresis of the lower extremity, often the end result of a cerebral vascular accident, may result in foot drop, trophic changes, and new weight-bearing areas for which the individual cannot compensate. These changes can turn minor foot lesions into ulcerations.

Many diseases of the neurologic system can affect the foot and ambulation, such as cerebral palsy with gait abnormalities, post-cerebral vascular accidents, and multiple sclerosis. However, the primary problems are associated with incoordination of movements as a result of spasticity ataxia, peripheral neuropathies resulting in a loss of position sense, visual defects affecting ambulation, and tremor and rigidity. Patients with mental illness or spastic cerebral palsy present foot defects and problems resulting from their inability to functionally adapt to gait and related system changes.

CONCLUSIONS

The attempt has been made to briefly outline the more common complications of some diseases present in an elderly population. It should be noted that the podiatric management of many of these involves management of the pathomechanics related to disease. The prime concern should be the total patient and the utilization of all health professionals as a team if comprehensive care is to be achieved.

SOME SUGGESTIONS TO THE INDIVIDUAL ON MAINTENANCE OF GOOD FOOT HEALTH

Foot Health

Proper foot care is of the utmost importance to you. Many major foot problems can be prevented by simple hygienic care. Your feet are important if you want to continue to walk and remain active. The following was prepared to help you understand the best way to care for your feet.

Exercise

Walking is the best exercise for your feet. Your doctor may advise special exercises.

Shoes

Your feet must have adequate protection and support. A shoe with a firm sole and soft upper is best for daily activities. Your shoes should conform to the shape of your feet and have comfortable heels. New shoes should be worn for short periods during the first week of wear. Casual shoes or slippers should be worn only for short intervals. All shoe corrections should be done on the advice of your podiatrist.

Socks

Socks or stockings of suitable material are recommended for daily wear. They should be of the correct size and free of seams or darns. To ensure cleanliness, change your socks every day. Loose woolen socks may be worn at night to help keep your feet warm.

Garters

Do not wear constricting garters or tie your stockings in knots * * * this can stop the circulation to your feet and legs. Do not wear constricting hose, such as elastic stockings unless they have been prescribed for you.

Corns and Calluses

These are growths of hard skin at points of pressure and should be treated by your Podiatrist. Never cut them with a razor, pocket knife, or any other instrument. Never pick at them with your finger nail. Never apply strong antiseptics, "corn cures" or other strong medications to your feet. These chemicals and other forms of self-treatment can burn your feet and cause a serious infection.

Bathing

Bathe your feet daily in lukewarm (not hot) water, using a mild soap. After thorough rinsing, gently blot your feet dry with a soft towel. Pay special attention to the skin between the toes. If your feet are rough and dry, rub them with a moisture restoring cream or lotion recommended by your Podiatrist. If your feet sweat excessively, rub them gently with alcohol and dust them with a recommended foot powder.

Toenails

Your toenails should be even with the ends of your toes. Trim or file your nails straight across. Do not cut the corners down and do not cut a "V" in the front of the nail. If your nails are especially thick, file them

with a sandpaper board, three times a week, after your foot bath.

Daily Inspection

Inspect your feet every day. If you notice any redness, swelling, cracks in the skin, or sores, consult your Podiatrist.

Give your feet some sun and air when possible and never allow your feet to be exposed to rain, cold, or excessive sunlight nor to extreme heat from heating pads, hot water, or hot water bottles.

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